E. M. ANDERSON
July 1959

FACE BRICK

Technical Information

TOMKINS BROTHERS

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A CORPORATION

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PRACTICAL SUGGESTIONS FOR BETTER BRICKWORK

Workmanship

Good workmanship in brickwork is as important as good brick and good mortar. The following suggestions will aid the securing of better workmanship.

Wet or Dry Brick

High absorption brick should be wetted so that the brick are damp when laid in a wall. This insures a better bond between brick and mortar.

Dimensional Stability

Any material used for backing up brick work should have the same dimensional stability due to temperature change or moisture content as the brick itself. Serious wall cracks and moisture penetration may develop if these volume change chacteristics are not evaluated.

Protection

All new brickwork should be protected from the elements for several days. On a hot day new brickwork should be kept damp by covering with canvas or burlap. Otherwise the heat will extract excessive water from the mortar. Water is essential for proper setting. On rainy, stormy days, boards and water-proof fabric should protect the wall top and the new brickwork directly under the top. Too much rain is apt to wash mortar out of joints. Also, wet walls expand and when bricklaying starts again there is apt to be a fracture between old and new parts.

Clean Work

It is advisable and economical to keep new brick walls clean as the work progresses. Care at this stage can eliminate or reduce cleaning costs.

How to Clean

Excessive chunks of mortar should be removed with a knife or cold chisel before the following directions are begun. First, wet with clear water the wall areas to be cleaned. Let the wall absorb as much water as possible. After wall is thoroughly wet, mortar stains are removed by scrubbing with a stiff brush and a weak solution of muriatic acid and water. This solution should not exceed a 10% solution. Following this acid bath the wall must be copiously washed with clean water. If great care is not exercised in the use of muriatic acid the mortar joints are apt to burn and be permanently discolored.

Grading Sand

Well graded sand as near ASTM specifications (C144-44) as possible is essential to good mortar.

Full Mortar Joints

Full mortar joints are essential to good brickwork. A proper working mortar of high water retentivity (type S lime) is easy to work and enables the bricklayer to fit all joints.

Tooled Mortar Joints

Raked or cut joints without tooling are apt to result in a leaky wall. Tooling will smooth the mortar, produce a dense surface and press the mortar firmly to the brick.

Parging

The back of the face brick should be parged (plastered) with mortar before placement of the backing. Such parging fills all mortar joints and, therefore, makes the wall as water tight as possible.

Double Tooling

This alternate practice for parging consists of tooling the inside mortar joints in the same manner as the exposed mortar joints are tooled. This is a double precaution against moisture penetration.

Efflorescence

Efflorescence is caused by water soluble salts which are carried to the surface and deposited as a white powdery substance upon evaporation of the water. Few if any well burned brick produced in the midwest, Pennsylvania or south-eastern states contribute to efflorescence.

Certain masonry units, other than structural clay units, usually contain soluble salts and may be a source of efflorescence. Portland cements contain soluble salts as do some limes, sands and even mixing waters. Proper design and good workmanship which prevent excessive water entering the wall either during or after construction are the best insurance against future efflorescence.

Standard Specifications for

FACING BRICK (SOLID MASONRY UNITS MADE FROM CLAY OR SHALE)[1]

ASTM Designation: C 216 - 50

ADOPTED, 1950.[2]

This Standard of the American Society for Testing Materials is issued under the fixed designation C 216; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

Scope

1. These specifications cover facing brick made from clay, shale, fire clay, or mixtures thereof and burned. Three types of brick in each of two grades are covered. In these specifications the term brick shall be understood to mean brick or solid clay masonry unit.

Grades

2. Two grades of facing brick are covered, as follows:

Grade SW.—Brick intended for use where a high and uniform degree of resistance to frost action and disintegration by weathering is desired and the exposure is such that the brick may be frozen when permeated with water (see Note 1).

Grade MW.—Brick intended for use where a moderate and somewhat nonuniform degree of resistance to frost action is permissible or where they are unlikely to be permeated with water when exposed to temperatures below freezing (see Note 2).

Types

3. Three types of facing brick are covered, as follows:

Type FBX.—Brick for general use in exposed exterior and interior masonry walls and partitions and for use where a high degree of mechanical perfection, narrow color range, and minimum permissible variation in size are desired.

Type FBS.—Brick suitable for general use in exposed exterior and interior masonry walls and partitions where wide color ranges are desired and where a greater variation in size is permitted or desired than is specified for type FBX.

Type FBA.—Brick manufactured and selected to produce characteristic architectural effects resulting from nonuniformity in size, color, and texture of the individual units.

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[1] Under the standardization procedure of the Society, these specifications are under the jurisdiction of the A.S.T.M. Committee C-15 on Manufactured Masonry Units.

[2] Prior to adoption as standard, these specifications were published as tentative from 1947 to 1950, being revised in 1948.

Physical Properties

4. (*a*) *Durability.*—The brick shall conform to the physical requirements for the grade specified as prescribed in Table I (see Note 3). When the grade is not specified, the requirements for grade MW shall govern. Unless otherwise specified by the purchaser, brick of grade SW shall be accepted in lieu of grade MW. If the average compressive strength is greater than 8000 psi. or the average water absorption is less than 8.0 per cent after 24-hr. submersion in cold water, the requirement for saturation coefficient shall be waived.

TABLE I.—PHYSICAL REQUIREMENTS.

Designation	Minimum Compressive Strength (brick flatwise) psi., gross area		Maximum Water Absorption by 5-hr. Boiling, per cent		Maximum Saturation Coefficient[a]	
	Average of 5 brick	Individual	Average of 5 brick	Individual	Average of 5 brick	Individual
Grade SW	3000	2500	17.0	20.0	0.78	0.80
Grade MW ..	2500	2200	22.0	25.0	0.88	0.90

[a] The saturation coefficient is the ratio of absorption by 24-hr. submersion in cold water to that after 5-hr. submersion in boiling water.

(*b*) *Strength.*—When brick are required having strengths greater than prescribed by these specifications, the purchaser shall specify the desired minimum compressive strength (see Note 4).

Efflorescence

5. When the brick are tested in accordance with the Standard Methods of Sampling and Testing Brick (A.S.T.M. Designation: C 67),[3] the rating for efflorescence shall not be more than "slightly effloresced."

Material, Workmanship, and Finish

6. (*a*) The body of all brick shall be of clay, shale, fire clay, or mixtures of these materials, with or without admixtures, burned to meet the requirements of these specifications. Any coloring or other materials added to the clay shall be suitable ceramic materials and shall be well distributed throughout the body. Unless otherwise specified by the purchaser, surface coloring shall not be applied to any brick other than by sanding or flashing.

[3] 1952 Book of ASTM Standards, Part 3.

TABLE II.—MAXIMUM PERMISSIBLE EXTENT OF CHIPPAGE FROM THE EDGES AND CORNERS OF FINISHED FACE OR FACES INTO THE SURFACE.

	Chippage in Inches in from	
	Edge	Corner
Type FBX	1/8	1/4
Type FBS (smooth)[a]......	1/4	3/8
Type FBS (rough)[b].......	5/16	1/2
Type FBA	Conforming to one of the above types or as specified by the purchaser.	

[a] Smooth texture is the unbroken natural die finish.
[b] Rough texture is the finish produced when the face is sanded, combed, scratched, or scarified or the die skin on the face is entirely broken by mechanical means such as wire-cutting or wire-brushing.

TABLE III.—PERCENTAGES OF SHIPMENT THAT MAY BE ALLOWED CHIPPAGE OVER MAXIMUM PERMISSIBLE IN TABLE II.

	Percentage Allowable	Chippage in Inches in from	
		Edge	Corner
Type FBX	5	1/4	3/8
Type FBS (smooth)	10	5/16	1/2
Type FBS (rough).....	15	7/16	3/4
Type FBA.............	Conforming to one of the above types or as specified by the purchaser.		

(*b*) The brick shall be free of cracks or other defects that would interfere with the proper setting of the brick or impair the strength or permanence of the construction. The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table II, except that percentages of the shipment may be allowed additional chippage which shall not exceed the limits given in Table III. The limits apply to the types as specified. The face or faces

shall be free of other imperfections detracting from the appearance of a sample wall when viewed from a distance of 15 ft. for type FBX and a distance of 20 ft. for types FBS and FBA.

(*c*) Unless otherwise agreed upon by the purchaser and the seller, a delivery of brick shall contain not less than 95 per cent whole brick.

Texture and Color

7. Unless otherwise specified by the purchaser, at least one end of the majority of the individual brick shall have the same general texture and general color tone as the approved sample. The texture of the finished surfaces that will be exposed when in place shall conform to an approved sample consisting of not less than four stretcher brick, each representing the texture desired. The color range shall be indicated by the approved sample.

Size

8. (*a*) *Size.*—The size of brick shall be as specified by the purchaser (see Notes 5 and 6). In a sample of ten brick selected to include the extreme range of color and size of brick to be supplied, no brick shall depart from the specified size by more than the individual tolerance for the type specified as prescribed in Table IV. Tolerances on dimensions for type *FBA* shall be as specified by the purchaser.

(*b*) *Warpage.*—Tolerances for distortion or warpage of face or edges of individual brick from a plane surface and from a straight line, respectively, shall not exceed the maximum for the type specified as prescribed in Table V. Tolerances on distortion for type FBA shall be as specified by the purchaser.

Coring and Frogging

9. (*a*) *Coring.*—Unless otherwise specified in the invitation for bids, brick shall be either solid or cored at the option of the seller. The net cross-sectional area of cored brick in any plane parallel to the bearing surface shall be at least 75 per cent of the gross cross-sectional area measured in the same plane. No part of any hole shall be less than ¾ in. from any edge of the brick.

TABLE IV.—TOLERANCES ON DIMENSIONS

Specified Dimension, in.	Maximum Permissible Variation from Specified Dimension, plus or minus, in.	
	Type FBX	Type FBS
3 and under	1/16	3/32
Over 3 to 4, incl.	3/32	2/16
Over 4 to 6, incl.	2/16	3/16
Over 6 to 8, incl.	5/32	4/16
Over 8 to 12, incl.	7/32	5/16

TABLE V.—TOLERANCES ON DISTORTION.

Maximum Face Dimension, in.	Maximum Permissible Distortion, in.	
	Type FBX	Type FBS
8 and under	1/16	3/32
Over 8 to 12, incl.	3/32	1/8

(*b*) *Frogging.*—Unless otherwise specified in the invitation for bids, one bearing face of each brick may have a recess or panel (frog) not exceeding ⅜ in. in depth, except that in brick containing deep frogs, any cross-section through the frogs parallel to the bearing surface shall conform to the requirements of Paragraph (*a*). No part of the recess shall be less than ¾ in. from any edge of the brick.

Sampling and Testing

10. (*a*) For purposes of tests, brick that are representative of the commercial product shall be selected by a competent person appointed by the purchaser, the place or places of selection to be designated when the purchase order is placed. The sample or samples shall include specimens representative of the complete

range of colors and sizes of the brick supplied or to be supplied. The manufacturer or the seller shall furnish specimens for tests without charge.

(*b*) The brick shall be sampled and tested in accordance with the Standard Methods of Sampling and Testing Brick (A.S.T.M. Designation: C 67).[3]

Cost of Tests

11. Unless otherwise specified in the purchase order, the cost of tests shall be borne as follows:

(*a*) If the results of the tests show that the brick do not conform to the requirements of these specifications, the cost shall be borne by the seller.

(*b*) If the results of the tests show that the brick do conform to the requirements of these specifications, the cost shall be borne by the purchaser.

EXPLANATORY NOTES

NOTE 1.—The term "permeated with water" in the description of the applicability of grades SW and MW refers to the following conditions: When water is in contact with the surface of a dry brick, the tendency is for water to enter the brick by capillary action. If there is enough water and the time of contact is sufficiently long, the water will strike through from face to face of the brick, giving a degree of saturation equalling or exceeding that resulting from a 24-hr. submersion in water. This wetting through from face to face is the condition of being permeated referred to in the description of grades SW and MW. Brick exposed in parapets in, horizontal surfaces, and as retaining walls may become permeated (Note 2). When suitably protected from above by flashings or overhanging eaves, ordinary exposure in the vertical face of an exterior wall is unlikely to result in permeation unless resulting from defective workmanship or faulty drainage.

NOTE 2.—In those sections of the United States where temperatures seldom fall below freezing, the degree of durability called for by grade SW of these specifications is unnecessary. Those portions of the South Atlantic states excluding mountainous areas, the Gulf states, and the Pacific coastal region would not require compliance with grade SW as far as resistance to frost action is concerned. The amount and nature of precipitation will obviously affect permeation and hence durability. Snow, for example, would not introduce water into vertical surfaces. Disregarding snow as precipitation, that portion of the United States west of a north and south line through the center of Kansas, and including the Rocky Mountain states would be considered as having an annual precipitation of less than 20 in. and hence does not require the SW grade to ensure durability.

NOTE 3.—Grade MW brick are for the most part well-burned brick, but this grade may include some brick that change materially in appearance when exposed to the freezing-and-thawing test.

It should be emphasized, however, that disintegration is not necessarily a characteristic of brick in this grade. Certain districts may supply brick under the grading, all of which remains unchanged in appearance even under severe conditions of exposure. The purchaser is advised to examine the field behavior of brick in districts where production is classified as grade MW and reach his own decision as to whether the appearance and condition of masonry is satisfactory.

NOTE 4.—A recommended classification is that given in American Standard Building Code Requirements for Masonry: A41.1–1944. In this code the following four grades of brick according to compressive strengths, tested flatwise, are recognized: 1500 to 2500 psi., 2500 to 4500 psi., 4500 to 8000 psi., and over 8000 psi.

NOTE 5.—Purchasers should ascertain the type and sizes of brick available in the locality under consideration and should specify accordingly, stating a size and type represented by the available brick. In general, brick having a wide range of colors will require greater tolerance for the full range of colors than for a restricted range of colors.

NOTE 6.—For a list of modular sizes, see the American Standard Sizes of Clay and Concrete Modular Masonry Units: A 62.3—1946. Not all of the sizes listed in this standard are produced in some parts of the United States, and purchasers should ascertain the size or sizes available.

VOL. 3 NO. 8 AUGUST, 1952

Technical Notes ON BRICK & TILE CONSTRUCTION

STRUCTURAL CLAY PRODUCTS INSTITUTE

GLOSSARY OF TERMS RELATING TO STRUCTURAL CLAY PRODUCTS

ABSORPTION (of brick or tile)—The amount of water the unit will absorb when immersed in either cold or boiling water for a stated length of time. It is expressed as a per cent of the weight of the dry brick or tile. See ASTM Standards C67- and C112-.

ABSORPTION RATE—The amount of water absorbed when the brick is partially immersed for one minute; usually expressed in either grams or ounces per minute. Also called *Suction Rate* or *Initial Rate of Absorption.*

ADMIXTURES—Materials added to mortar as water-repellent or coloring agents or to retard or speed-up setting.

ANCHOR—A piece or connected pieces of metal used to attach building parts such as plates or joists to masonry or to masonry materials.

APRON WALL—That part of a panel wall between the window sill and the support of the panel wall.

ARCH—A curved structural member used to span openings or recesses; also built flat. Structurally, an arch is a piece, or assemblage of pieces so arranged over an opening that the supported load is resolved into pressures on the side supports, and practically normal to their faces.

Back Arch. A concealed arch carrying the backing or inner part of a wall where the exterior facing material is carried by a lintel.

Jack Arch. One having horizontal or nearly horizontal upper and lower surfaces. May also be called a *Flat* or *Straight* arch. The term is also used for any arch roughly built.

Relieving Arch. One built over a lintel, or similar opening in a wall, and intended to divert the superimposed load above the opening to the piers or abutments on both sides, thus relieving the lintel or flat arch from excessive loading. Also known as a *Discharging* or *Safety* arch.

Trimmer Arch. An arch, usually of brickwork and of low rise used for supporting the fireplace hearth.

ARCHITECTURAL TERRA COTTA—Plain or ornamented (machine-extruded or hand-molded) hard burned clay building units, generally larger in size than brick and most facing tile, and having a glazed or unglazed ceramic finish in an unlimited variety of colors. See CERAMIC VENEER also.

AREA WALL—The masonry surrounding or partly surrounding an area. Also the retaining wall around basement windows below grade.

ASHLAR MASONRY—Masonry composed of rectangular units of burned clay or shale, or stone, generally larger in size than brick and properly bonded, having sawed, dressed or squared beds, and joints laid in mortar.

ASTM—American Society for Testing Materials.

BACK FILLING—Rough masonry built in behind the facing, or between two faces; similar material used in filling over the extrados of an arch. Also brickwork used to fill in space between studs in a frame building, sometimes called *Brick Nogging.*

BACKUP—That part of a masonry wall behind the exterior facing. See Technical Notes, Vol. 2—No. 3.

BAT—A piece of broken brick.

BATTER—Recessing or sloping a wall back in successive courses; the opposite of corbel.

BEARING PARTITION—An interior wall one story or less in height which supports any load in addition to its own weight.

BEARING WALL—A wall which supports a vertical load in addition to its own weight.

BED JOINT—The horizontal layer of mortar on or in which a masonry unit is laid.

BELT COURSE—A narrow, vertically faced course of masonry, sometimes slightly projected such as window sills which are made continuous. Also used to divide walls into stories and stages. Sometimes called *String Course* or *Sill Course.*

BLIND HEADER—A concealed brick header in the interior of a wall, not showing on the faces.

BLOCKING—A method of bonding two adjoining or intersecting walls, not built at the same time, by means of offsets and overhanging blocks.

BOND—Tying the various parts of a masonry wall by lapping one unit over another. Also refers to the pattern formed by the exposed faces of the unit. The adhesion of the mortar to the units is also referred to as the bond. See Technical Notes, Vol. 1—No. 7.

BOND COURSE—The course consisting of units which overlap those below.

BREAKING JOINTS—The arrangement of masonry units so as to prevent continuous vertical joints in adjacent courses.

BRICK—A solid masonry unit of burned clay or shale, formed while plastic into a rectangular prism and burned in a kiln.

Acid Resistant Brick. A brick suitable for use where it will be in contact with chemicals and designed primarily for use in the chemical industry. Usually used with acid-resistant mortars. See ASTM Specifications C279-.

Adobe Brick. A large clay brick, of varying size, roughly molded and sun dried.

Angle Brick. Any brick shaped to an oblique angle to fit a salient corner.

Arch Brick. A wedge shaped brick for special use in an arch; also an extremely hard-burned brick from an arch of a scove kiln.

Building Brick. Any brick made primarily for building purposes and not especially treated for texture or color. Formerly called *Common Brick.* See ASTM Specificiations C62-.

Clinker Brick. A very hard-burned brick, burned to the point of complete vitrification and whose shape is somewhat distorted or bloated.

Common Brick. See Building Brick.

Dry-Press Brick. Brick produced by a process of forming relatively dry clay (5 to 7% moisture content) in molds at pressures of from 550 to 1500 psi.

Economy Brick. A brick whose nominal dimensions are 4" x 4" x 8", laying up one course to every 4 in.

Engineered Brick. A brick whose nominal dimensions are 3.2" x 4" x 8", laying up five courses to 16 in.

Facing Brick. A brick made especially for facing purposes, often treated to produce surface texture and made of selected clays or otherwise treated to produce desired color. See ASTM Specifications C216-.

Fire Brick. One made of refractory ceramic material which will resist high temperatures.

Floor Brick. A smooth dense brick, highly resistant to abrasion and used as a finished floor surface.

Gauged Brick. A brick which has been ground or otherwise produced to accurate dimension. An arch brick.

Jumbo Brick. A generic term indicating a brick larger in size than the

standard. Some producers, however, use this term to describe an oversize brick unit of specific dimensions which they manufacture.

Norman Brick. A brick whose nominal dimensions are 2⅔" x 4" x 12", laying up three courses to 8 in.

Paving Brick. A vitrified brick especially suitable for use in pavements where resistance to abrasion is important. See ASTM Specifications C7-.

Roman Brick. A brick whose nominal dimensions are 2" x 4" x 12", laying up two courses to 4 in. These brick are sometimes made 16 in. or more in length.

Salmon Brick. A relatively soft, underburned brick, so called because of its color. Sometimes referred to as a *chuff* or *place* brick.

Soft-Mud Brick. Brick produced by a process of forming relatively wet clay (20 to 30% water content) in molds. When the inside of the molds are sanded, the product is called "sand-struck" brick. When molds are wetted with water to prevent sticking of the clay, the brick are called "water-struck."

Stiff-Mud Brick. Brick produced by extruding through a die a plastic clay with a water content of from 12 to 15%.

"SCR brick"* A brick whose nominal dimensions are 2⅔" x 6" x 12", laying up three courses to 8 in. This brick, with norman brick face dimensions, builds a nominal 6 in. thick wall. See Technical Notes, Vol. 3—No. 5.

Sewer Brick. A low absorption, abrasive resistant brick designed for use in drainage structures for the conveyance of sewerage, industrial wastes and storm water. See ASTM Specifications C32-.

BRICK AND BRICK—A method of laying brick so that the units touch each other with only enough mortar to fill the surface irregularities.

BUTTERING—Placing mortar on the brick or other masonry unit with a trowel before laying.

CAVITY WALL—A wall built of masonry units so arranged as to provide a continuous air space at least 2 in. wide and not more than 3 in. wide within the wall. The facing and backing are tied together with rigid metal ties. See Technical Notes, Vol. 1—No. 6 and Vol. 2—No. 5.

CENTER—A temporary timber framework upon which the masonry of an arch or reinforced masonry lintel is supported until it becomes self-supporting.

CERAMIC COLOR GLAZE—An opaque colored glaze of bright satin or gloss finish obtained by spraying the clay body with a compound of metallic oxides, chemicals and clays and burning at high temperatures, fusing the glaze to the body, making them inseparable. See Facing Tile Institute Specifications or ASTM Specifications C126-.

CERAMIC VENEER—A type of architectural terra cotta, characterized by larger face dimensions and thinner sections ranging from 1⅛ in. to 2½ in. in thickness. See Technical Notes, Vol. 3—No. 6.

Adhesion Type. Ceramic slabs approximately 1⅛ in. in thickness held in place by the adhesion of the mortar to the ceramic veneer and the backing wall. No metal anchors are required.

Anchored Type. Ceramic slabs approximately 2 to 2½ in. in thickness held in place by wire anchors and a grout space in which vertical pencil rods are placed. The slabs are anchored to the rods, which, in turn, are anchored to the backing wall.

CHASE—A continuous vertical recess built into a wall to receive pipes, ducts, etc.

CLAY MORTAR-MIX—A finely ground clay used as a plasticizer for masonry mortars.

CLEAR CERAMIC GLAZE—Same as ceramic color glaze except that it is translucent or tinted with a gloss finish. See Facing Tile Institute Specifications or ASTM Specifications C126-.

CLOSER—The last brick or tile laid in a course. A closer may be a whole unit or one that is shorter and usually appears in the field of the wall.

CLOSURE—A supplementary or shorter length unit with closed ends, used adjacent to corners or at jambs in order to maintain the bond.

C/B RATIO—A measure of the resistance to freezing and thawing of a brick. It is the ratio of the weight of water absorbed by cold immersion (24 hr.) to the weight absorbed by immersion in boiling water (5 hr.); also known as the *Saturation Coefficient.* See ASTM Standard, C67-.

COLLAR JOINT—The interior longitudinal vertical joint in a multi-unit masonry wall.

COPING—The material or units used to form a cap or finish on top of a wall, pier or pilaster to protect the masonry below from the penetration of water from above.

CORBEL—A shelf or ledge formed by projecting successive courses of masonry out from the face of the wall.

COURSE—One of the continuous horizontal layers of masonry bonded together with mortar and forming the masonry structure.

CURTAIN WALL—A non-bearing wall built between columns or piers for the enclosure of a building but not supported at each story.

DAMP COURSE—A course or layer of impervious material in a wall or floor to prevent the entrance of moisture from the ground or a lower course by capillarity.

DOGS TOOTH—Brick so laid that their corners project from the face of the wall.

DRIP—A projecting piece of material so shaped as to throw off water and prevent its running down the face of the wall or other surface of which it is a part.

DWARF WALL—Walls or partitions which do not extend to the ceiling; also interior walls between the topmost ceiling level and the finished roof level.

EFFLORESCENCE—A whitish powder, sometimes found on the surface of masonry by deposition of soluble salts. See Technical Notes, Vol. 1—No. 2.

ENCLOSURE WALL—An exterior non-bearing wall in skeleton frame construction, anchored to columns, piers or floors, but not necessarily built between columns or piers nor wholly supported at each story.

EXTERIOR WALL—Any outside wall or vertical enclosure of a building other than a party wall.

FACE—The exposed surface of a wall or masonry unit.

FACING—Any material, forming a part of a wall, used as a finishing surface.

FACED WALL—A wall in which the facing and backing are so bonded with masonry or otherwise tied as to exert common action under load.

FAT MORTAR—A mortar that tends to be sticky and adheres to the trowel.

FIELD—The expanse or area of wall between openings, corners, etc., composed for the most part of stretcher units.

FILTER BLOCK—A hollow vitrified clay masonry unit, sometimes salt-glazed, designed for use in trickling filter floors in sewage disposal plants. See ASTM Specifications, C159-.

FIRE DIVISION WALL—Any wall which subdivides a building so as to resist the spread of fire, but is not necessarily continuous through all stories to and above the roof.

FIRE WALL—Any wall which subdivides a building so as to resist the spread of fire, by starting at the foundation and extending continuously through all stories to and above the roof.

FIRE RESISTIVE MATERIAL—See Incombustible Material.

FIREPROOFING—Any material or combination of materials used to enclose structural members so as to make them fire resistive. See Technical Notes, Vol. 1—No. 11.

FLARE HEADER—A brick burned on one end to a darker color than the face.

FOUNDATION WALL—That portion of a load-bearing wall below the level of the adjacent grade, or below the first floor beams or joists.

FROG—A depression in the bed surface of a brick. Sometimes called a *Panel.*

FURRING—A method of finishing the inside of a masonry wall so as to provide an air space for insulation, to prevent transmittance of moisture and to level up irregularities in the wall surface. May consist of wood or metal strips attached to wall to which lath is applied, or clay tile units to which plaster is applied directly.

GROUNDS—Nailing strips, usually wood, placed in masonry walls to which trim or furring is attached.

GROUT—Mortar to which sufficient water has been added to make a consistency that will flow without segregation of the ingredients.

HACKING—Laying brick so that the bottom edge is set in from the

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*Reg. T.M., SCPRF, Pat. Pending.

plane surface of the wall. Also the procedure of stacking brick in a kiln.

HARD BURNED—A term applied to clay products which have been fired at high temperatures to near vitrification, producing relatively low absorptions and high compressive strengths.

HEAD JOINT—The vertical mortar joint between ends of masonry units; sometimes called the *Cross Joint*.

HEADER—A masonry unit laid flat and with its greatest dimension perpendicular to the face of the wall. Generally used to tie two wythes of masonry together.

HEADING COURSE—A continuous bonding course of header brick. Also called *Header* course.

HEIGHT (of wall)—The vertical distance measured from the top of the foundation wall, or from a girder or other intermediate support of the wall, to the top, including parapet.

HOG (in a wall)—A wall that is hogged is one in which for any given height at both ends, there is a different number of courses, necessitating adjustment of mortar bed joints or the use of supplementary height units in the field.

HOLLOW MASONRY UNIT—A masonry unit whose net cross-sectional area in any plane parallel to the bearing surface is less than 75% of its gross cross-sectional area measured in the same plane.

HOLLOW WALL—A wall built of masonry units so arranged as to provide an air space within the wall, and in which the facing and backing are bonded together with masonry units.

HYDRATED LIME—Quicklime to which sufficient water has been added to convert the oxides to hydroxides. See also LIME PUTTY.

INCOMBUSTIBLE (building material)—Any building material which contains no matter subject to rapid oxidation within the temperature limits of a standard fire test of not less than 2½ hours duration. See ASTM Standard E119-. Materials which continue to burn after this time period are termed combustible.

KILN RUN—Brick or structural clay tile from one kiln which have not been sorted or graded for size or color variation.

KING CLOSER—A brick cut diagonally so as to have one end 2 in. wide and the other full width.

LATERAL SUPPORT (of walls)—Means whereby walls are braced either vertically or horizontally by columns, pilasters or crosswalls or by floor or roof constructions, respectively.

LEAD—The section of a wall built up and racked back on successive courses at the corner of a building. The line is attached to the leads and the wall then built up between them.

LEAN MORTAR—A mortar that, due to a deficiency of cementicious material, is harsh and difficult to spread.

LIME PUTTY—Hydrated lime in a plastic form ready to be added to mortar.

LINTEL—A beam placed over an opening in a wall to carry the superimposed weight above. See Technical Notes, Vol. 2—No. 1 and Vol. 2—No. 2.

LIPPING—Laying brick so that the top edge of the unit is set in from the plane surface of the wall.

MASONRY (unit)—Brick, tile, stone or other similar building units, or combinations thereof, bonded together with mortar.

MASONRY CEMENT—A masonry mortar, mixed at the mill, to which only the proper amount of sand and water must be added. See ASTM Specifications C91-.

MODULAR MASONRY UNIT—A masonry unit whose nominal dimensions are based on the 4 in. module.

MORTAR—A plastic mixture of cementitious materials, fine aggregate and water. See ASTM Specifications C270-, and Technical Notes, Vol. 2—No. 7.

MORTAR AGGREGATE—Fine granular material composed of hard, strong and durable mineral products free of injurious amounts of saline, alkaline, organic or other deleterious substances. See ASTM Specifications C144-.

MULTI-UNIT WALL—A wall composed of two or more wythes of masonry.

NOMINAL DIMENSION—A dimension which may be greater than the specified masonry dimension by the thickness of a mortar joint, but not more than ½ in.

PANEL WALL—A non-bearing wall in skeleton frame construction, built between columns or piers, and wholly supported at each story.

PARAPET WALL—That part of any wall entirely above the roof line.

PARTITION—An interior wall one story or less in height.

PARGETING—The process of applying a coat of cement mortar to the back of the facing material or the face of the backing material; sometimes referred to as *Parging*.

PARTY WALL—A wall used for joint service by adjoining buildings.

PICK AND DIP—A method of laying brick by which the bricklayer simultaneously picks up a brick with one hand and, with his other hand, enough mortar on the trowel to lay the brick. Sometimes called the *Eastern* or *New England* method.

PIER—An isolated column of masonry.

PILASTER—An engaged pier, built as an integral part of a wall, and projecting from either or both surfaces.

POINTING—Troweling mortar into a joint after the masonry unit is laid.

QUEEN CLOSER—A brick cut so as to have a nominal 2-in. horizontal face dimension.

QUOIN—An exterior masonry corner.

RACKING—A method of building the end of a wall by stepping back each course, so that it can be built onto and against without toothers; also used in corner leads.

RAGGLE—A groove or channel in a mortar joint, or in a special masonry unit (raggle block), to receive roofing, flashing or other material which is to be sealed in the masonry.

REINFORCED BRICK MASONRY (RBM)—Brick masonry in which steel reinforcing bars are embedded in such a manner that the two materials act together in resisting forces.

REINFORCED GROUTED BRICK MASONRY (RGBM)—Reinforced brick masonry in which the continuous longitudinal vertical or collar joint is filled with grout as the wall is built. No masonry headers are used in this type of construction.

RETURN—Any surface turned back from the face of a principal surface.

REVEAL—That portion of a jamb or recess which is visible from the face of a wall back to the frame placed between jambs.

ROWLOCK—A brick laid on its face edge. Usually laid in the wall with its long dimension perpendicular to the wall face. Frequently spelled "Rolok." Sometimes called *Bull-header*.

SALT GLAZE—A gloss finish obtained by the thermochemical reaction of the silicates of the clay body with vapors of salt or chemicals. See Facing Tile Institute Specifications.

SATURATION COEFFICIENT — See C/B Ratio.

SHOVED JOINTS—Head or vertical joints filled by buttering the ends of the units with mortar and shoving them against the units previously laid.

SLUSHED JOINTS—Head joints filled after units are laid by "throwing" mortar in with edge of trowel.

SOFFIT—The underside of a beam, lintel or reveal.

SOFT BURNED—A term applied to clay products which have been fired at low temperature ranges so as to have relatively high absorptions and low compressive strengths.

SOLDIER—A brick laid on its end so that its greatest dimension is vertical.

SOLID MASONRY UNIT—A unit whose net cross-sectional area in every plane parallel to the bearing surface is 75% or more of its gross cross-sectional area measured in the same plane.

SOLID MASONRY WALL—A wall built of solid masonry units, laid contiguously with the joints between units completely filled with mortar.

SPALL—A small fragment removed from the face of a masonry unit by a blow or by the action of the elements.

SPANDREL WALL—That part of a curtain wall above the top of a window in one story and below the sill of the window in the story above.

STACK—Any structure or part of a structure partly or wholly exposed to the atmosphere, which contains a flue or flues for the discharge of gases.

STORY POLE—A pole marked by the bricklayer and used to measure vertical heights during the construction of the wall.

STRETCHER—A masonry unit laid with its greatest dimension parallel to the face of the wall.

STRINGING MORTAR—The procedure of spreading enough mortar on

the bed joint to lay several masonry units.

STRUCK JOINT—Any mortar joint which has been finished with the trowel.

STRUCTURAL CLAY TILE—A hollow masonry building unit composed of burned clay, shale, fire clay or mixtures thereof and having parallel air cells.

End-construction Tile. Tile designed to be laid with the axes of the cells vertical.

Facing Tile. Tile designed for use in exterior or interior walls, partitions or columns where the faces of the units are to be left exposed. See ASTM Specifications C212- and C126-; also Specifications of Facing Tile Institute.

Fireproofing Tile. Tile designed for use as a protection for structural members against fire.

Floor Tile. Tile for use as structural units in floor and roof slab construction. See ASTM Specifications C57-.

Furring Tile. Tile designed for lining the inside of exterior walls and carrying no superimposed loads.

Header Tile. Tile designed to provide recesses for brick header units in masonry faced walls.

Load-bearing Tile. Tile designed for use in masonry walls carrying superimposed loads. See ASTM Specifications C34—.

Non-load-bearing Tile. Tile designed for use in masonry walls carrying no superimposed loads. See ASTM Specifications C56-.

Partition Tile. Tile designed for use in interior partitions.

Side Construction Tile. Tile designed to be laid with the axes of its cells horizontal.

TEMPER—To moisten and mix clay, plaster or mortar to the proper consistency for use.

TIE—Any unit of material used to resist the separation of a multi-unit masonry wall.

TOOLING—Compressing and shaping the face of a mortar joint with a special tool other than a trowel.

TOOTHER—A masonry unit projecting from the end of a wall against which another wall is to be built.

TOOTHING—The temporary end of a wall built so that the end stretcher of every alternate course projects.

TUCK POINTING—The filling in with fresh mortar of cut-out or defective mortar joints in old masonry.

VENEERED WALL—A wall having a masonry facing which is attached to the backing but not so bonded as to exert common action under load.

VITRIFIED—That characteristic of a clay product resulting when the temperature in the kiln is sufficient to fuse all the grains and close all the pores of the clay, making the mass impervious.

WALL PLATE—A horizontal member, usually of wood, bolted to a masonry wall to which the frame construction is attached. Also called *Head Plate.*

WALL PLATE ANCHOR—A machine bolt anchor with a head at one end and threaded at the other, and fitted with a plate or punched washer so that when embedded in the masonry it will be securely anchored and will hold the wall plate in place.

WALL TIE (veneer)—A strip or piece of metal used for tying a facing veneer to the backing.

WALL TIE (cavity)—A rigid, corrosion resistant steel or other metal tie used to bond the two wythes of a cavity wall together; usually 3/16 in. in diameter and formed in a "Z" or a rectangle.

WATER RETENTIVITY—That property of a mortar which prevents the rapid loss of water to masonry units of high suction or initial rate of absorption and "bleeding" or "water gain" when the mortar is in contact with relatively impervious units.

WATER TABLE—A slight projection of the lower masonry on the outside of the wall and slightly above the ground.

WEEP HOLES—Suitably formed holes or openings placed in the mortar joints of the facing material at the level of flashing so as to permit the escape of any moisture collected by the flashing.

WESTERN METHOD—The method of laying brick in which the bricklayer employs the stringing method with shoved joints.

WYTHE (or withe)—Each continuous vertical 4 in. or greater section or thickness of masonry; the thickness of masonry separating flues in a chimney; also called a *Tier.*

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Technical Notes ON BRICK & TILE CONSTRUCTION

STRUCTURAL CLAY PRODUCTS INSTITUTE

ESTIMATING TABLES FOR MODULAR BRICK AND TILE

INTRODUCTION

Tables giving the quantities of non-modular brick and tile and mortar required for various types of walls are readily available. The tables in this bulletin, therefore, will be devoted exclusively to *modular* clay masonry units. It is readily apparent in comparing estimating tables for non-modular units with those for modular units that the job of taking off masonry material quantities is greatly simplified under the modular system. No matter what the mortar joint thickness, the number of modular units of any given size required per square foot of wall will be the same. Under the old non-modular system, the number of brick required per square foot, for example, would vary with the joint thickness. Under the modular system there are only 3 standard joint thicknesses; ¼ in. for glazed brick and tile, ⅜ in. or ½ in. for facing brick and unglazed facing tile, and ½ in. for building brick and structural tile.

ESTIMATING METHODS

Because of its simplicity and accuracy, the estimating procedure most widely used is the wall area method. This method consists simply of multiplying the net wall areas (gross areas less the areas of all openings) by the number of brick or tile required per square foot. The condensed tables that follow contain the number of units of various sizes required per square foot and the cubic feet of mortar for joints of different thicknesses.

To the quantity of masonry units computed as above should be added a percentage for breakage. Such breakage allowances vary according to the type of units and the job conditions. As a general rule, 2% is added to the net tile quantities and 5% to the net quantity of brick. The tables shown here include a 10% allowance for waste for the mortar quantities.

TABLE 1

Four-inch Brick Facing Walls in Running Bond
(Full Bed and Head Joints)

NOMINAL SIZE OF BRICK*	NUMBER OF BRICK PER. SQ FT. OF WALL..	CU. FT. OF MORTAR PER. SQ. FT. OF WALL**		CU FT OF MORTAR PER. 1000 BRICK**	
		3/8" JOINT	1/2" JOINT	3/8" JOINT	1/2" JOINT
2 2/3 x 4 x 8	6.75	0.0608	0.0765	8.90	11.30
2 2/3 x 4 x 12	4.50	0.0535	0.071	11.90	15.80
2 x 4 x 12	6.00	0.0676	0.09	11.30	15.00
4 x 4 x 8	4.50	0.0432	0.0575	9.60	12.80
4 x 4 x 12	3.00	0.039	0.052	13.00	17.30

*Actual size plus thickness of one joint
**10% added for waste.

In Table 1 are the quantities of units and mortar required to construct a 4-in. wall using 5 sizes of modular brick with two joint thicknesses. The mortar quantities shown are for the bed and head joints only. If this facing is to be applied to a backup wall, the quantity of mortar required for the interior vertical or collar joint must be added. These quantities are as follows:

.0313 cu. ft. for 1 sq. ft. mortar joint ⅜ in. thick
.0365 cu. ft. for 1 sq. ft. mortar joint 7/16 in. thick
.0417 cu. ft. for 1 sq. ft. mortar joint ½ in. thick

The brick quantities shown are for brick laid in running bond. For other bonds in which full headers are used, the correction factors in Table 3 must be added. The 2-2/3 x 4 x 8-in. size brick is commonly referred to as the "Standard Modular" size.

TABLE 2

Eight- and Twelve-inch Brick Backup Walls in Running Bond
(Full Bed, Head and Collar Joints)

NOMINAL SIZE OF BRICK*	8" WALL			12" WALL		
	NUMBER OF BRICK	CU. FT. OF MORTAR** 3/8" JOINT	CU. FT. OF MORTAR** 1/2" JOINT	NUMBER OF BRICK	CU FT. OF MORTAR** 3/8" JOINT	CU FT. OF MORTAR** 1/2" JOINT
2 2/3 x 4 x 8	13.50	0.1544	0.1988	20.25	0.2489	0.3211
4 x 4 x 8	9.00	0.1210	0.1610	13.50	0.1984	0.2641

* Actual size plus thickness of one joint
**10% added for waste
Mortar for interior vertical joints (parging or plastering) per 100 sq ft of joint
3.13 cu ft. ———— 3/8" joint
3.65 cu ft. ———— 7/16" joint
4.17 cu ft. ———— 1/2" joint

Since Table 2 will be used primarily to compute the quantities of backup brick required, only the two sizes of brick that would be commonly used for such purposes are shown. Here again, the quantities must be adjusted for the proper bond selected, using Table 3.

TABLE 3

Correction Factors to be Applied to 4-in. Wall Quantities in Table 1 for Estimating the Required Number of Facing Brick in Various Bonds

TYPE OF BOND	CORRECTION FACTOR
Common, with full header every 5th course....	20.0% or 1/5
Common, with full header every 6th course....	16.7% or 1/6
Common, with full header every 7th course....	14.3% or 1/7
English, alternate courses full headers....	50.0% or 1/2
English or Dutch, with full headers every 6th course and blind headers in intermediate courses ...	16.7% or 1/6
Flemish, with alternate stretchers and full headers every course..	33.3% or 1/3
Flemish, with stretchers and full headers every 6th course, intermediate courses with blind headers....	5.6% or 1/18
Flemish cross, alternate courses with stretchers and headers	16.7% or 1/6
Double header and stretcher every 6th course ...	8.3% or 1/12
Double header and stretcher every 5th course ...	10.0% or 1/10

The correction factors shown in Table 3 must be applied to the quantities of brick determined by using Table 1 if other than running bond is to be used. These correction factors are *added* to the facing brick quantities and *deducted* from the backup. If backup tile are to be used, the brick equivalent quantities to be deducted must be converted to tile quantities, using Table 5.

TABLE 4

Structural Clay Tile Walls

NOMINAL SIZE OF TILE*	POSITION OF CELLS WHEN LAID	BED JOINT	TILE PER SQ. FT. OF WALL	CU FT OF MORTAR**			
				SQ FT OF WALL		1000 UNITS	
				3/8" JOINT	1/2" JOINT	3/8" JOINT	1/2" JOINT
4x4x12	Horizontal	Full	3.00	0.0344	0.0443	11.5	14.8
4x4x12	Vertical		3.00	0.0243	0.0315	8.1	10.5
4x5 1/3x12	Horizontal	Full	2.25	0.0267	0.0344	11.9	15.3
4x5 1/3x12	Vertical		2.25	0.0211	0.0273	9.4	12.1
4x8x12	Horizontal	Full	1.50	0.01897	0.0245	12.7	16.4
4x8x12	Vertical		1.50	0.0179	0.0231	11.9	15.4
4x12x12	Horizontal	Full	1.00	0.0149	0.0199	14.9	19.9
4x12x12	Vertical		1.00	0.0168	0.0222	16.8	22.2
8x4x12	Horizontal	Full	3.00	0.0688	0.0901	22.9	30.0
8x4x12	Horizontal	Divided	3.00	0.0505	0.0672	16.8	22.4
8x4x12	Vertical		3.00	0.0254	0.0333	8.5	11.1
8x5 1/3x12	Horizontal	Full	2.25	0.0525	0.0688	23.3	30.6
8x5 1/3x12	Horizontal	Divided	2.25	0.0388	0.0516	17.2	22.9
8x5 1/3x12	Vertical		2.25	0.0222	0.0292	9.9	13.0
8x8x12	Horizontal	Full	1.50	0.0362	0.0474	24.1	31.6
8x8x12	Horizontal	Divided	1.50	0.0271	0.0356	18.0	24.0
8x8x12	Vertical		1.50	0.0189	0.0258	12.6	17.2
12x12x12	Horizontal	Full	1.00	0.0367	0.0485	36.7	48.5
12x12x12	Vertical		1.00	0.0168	0.0223	16.8	22.3

*Actual size plus thickness of one joint

**10% added to side construction and 20% to end construction tile for waste

As shown in Table 4, the quantity of mortar required for any one particular size tile will vary with the position of the cells when the tile is laid in the wall. A tile laid with its cells horizontal will require more mortar than one laid with its cells in a vertical position. Likewise, a horizontal cell tile with re-entrant spaces on the bed shells, permitting a "divided" mortar bed joint, will require less mortar than a horizontal cell tile with a flat bed which requires a full width mortar bed.

Table 4 includes estimating information for all of the standard modular sizes of structural clay tile.

TABLE 5

Brick and Tile Equivalents

NOMINAL SIZE OF TILE	EQUIVALENT BRICK UNITS	
	2 2/3x4x8	4x4x8
4 x 4 x 12	2.25	1.50
4 x 5 1/3 x 12	3.00	2.00
4 x 8 x 12	4.50	3.00
8 x 4 x 12	4.50	3.00
8 x 5 1/3 x 12	6.00	4.00
8 x 8 x 12	9.00	6.00
12 x 12 x 12	20.25	13.50
4 x 12 x 12	6.75	4.50

Quite often, it is necessary to figure the number of brick required to replace a certain number of tile of a specific size, or vice versa. Table 5 enables the estimator to do that with a minimum of effort.

TABLE 6

4-inch Structural Clay Facing Tile Walls in Running Bond (Full Bed Joints and, for Series 4S, Full Head Joints)

NOMINAL FACE SIZE OF TILE*	NUMBER OF TILE PER SQ FT. OF WALL AREA	CU FT. OF MORTAR**			
		PER SQ. FT. OF WALL		PER 1000 UNITS	
		1/4" JOINT	3/8" JOINT	1/4" JOINT	3/8" JOINT
4S 2 2/3 x 8	6.75	0.042	0.0608	6.2	8.9
4D 5 1/3 x 8	3.375	0.0206	0.0297	6.1	8.8
6T 5 1/3 x 12	2.25	0.0193	0.0267	8.5	11.9
8W 8 x 16	1.125	0.0131	0.019	11.6	16.9

*Actual size plus thickness of one joint

**10% added for waste

Select and standard quality ceramic glaze and salt glaze facing tile are designed for use with ¼-in. mortar joints, while smooth unglazed facing tile is dimensioned to be used with either ¼-in. or ⅜-in. mortar joints. The 4D and 6T series may be either horizontal cell or vertically cored at the option of the manufacturer. However, there would be no significant difference in the volume of mortar required for either type.

TABLE 7

Free Standing Chimneys of Various Sizes

SIZE OF FLUE LINING*	ONE WYTHE OF BRICK			TWO WYTHES OF BRICK		
	BRICK	CU. FT. OF MORTAR**		BRICK	CU. FT. OF MORTAR**	
		3/8" JOINT	1/2" JOINT		3/8" JOINT	1/2" JOINT
4 x 8	22.5	0.29	0.344	63.0	0.86	1.01
4 x 12	27.0	0.362	0.427	72.0	1.00	1.18
4 x 16	31.5	0.433	0.509	85.5	1.19	1.39
8 x 8	27.0	0.362	0.427	72.0	1.00	1.18
8 x 12	31.5	0.433	0.509	85.5	1.19	1.39
8 x 16	36.0	0.504	0.591	90.0	1.29	1.51
12 x 12	36.0	0.504	0.591	90.0	1.29	1.51
12 x 16	40.5	0.573	0.671	99.0	1.43	1.67
16 x 16	45.0	0.645	0.753	108.0	1.57	1.83
16 x 20	49.5	0.716	0.834	117.0	1.71	1.99
20 x 20	54.0	0.787	0.916	126.0	1.85	2.16
20 x 24	58.5	0.857	0.997	135.0	1.99	2.32
24 x 24	67.5	0.967	1.13	148.5	2.18	2.53

*Nominal outside dimensions.
**Mortar quantities include slushing between brick and liner, also the vertical collar joint in case of two wythes.

When both modular flue linings and modular brick are used, Table 7 will permit the estimator to determine easily the quantities of brick and mortar required per foot of height of free standing chimneys.

The sizes of clay flue linings shown are those adopted as "American Standards" by the American Standards Association. These dimensions are *nominal* outside dimensions, the *actual* outside dimensions being ½ in. less in both directions. In all cases, the standard lengths are 24 in. No standards have been set up as yet (1950) for *round* modular flue linings.

TABLE 8

Quantities of Cement, Lime and Sand Required Per Cubic Foot of Mortar

TYPE A MORTAR					
BY WEIGHT — LB.			BY VOLUME — CU. FT.		
CEMENT	HYDRATED LIME	SAND	CEMENT	HYDRATED LIME	SAND
28.2	3	73.6	0.3	.075	0.92
TYPE B MORTAR					
BY WEIGHT — LB.			BY VOLUME — CU. FT.		
CEMENT	HYDRATED LIME	SAND	CEMENT	HYDRATED LIME	SAND
15.28	6.5	78.4	0.163	0.163	0.983
TYPE C MORTAR					
BY WEIGHT — LB.			BY VOLUME — CU. FT.		
CEMENT	HYDRATED LIME	SAND	CEMENT	HYDRATED LIME	SAND
10.34	8.75	79.2	0.11	0.22	0.99

Three types of mortar are shown in Table 8 and may be described as follows:

Type A. Proportions by volume; 1 part portland cement, ¼ part hydrated lime or lime putty and 3 parts sand. This is a high strength mortar suitable for general use and recommended specifically for masonry below grade and in contact with earth and for reinforced brick masonry.

Type B. Proportions by volume; 1 part portland cement, 1 part hydrated lime or lime putty and 6 parts sand. This is a medium strength mortar suitable for general use in exposed masonry above grade.

Type C. Proportions by volume; 1 part portland cement, 2 parts hydrated lime or lime putty and 9 parts sand. This is a low strength mortar suitable for non-load-bearing walls. It may also be used for load-bearing construction where the masonry will not be subjected to freezing and thawing in the presence of excessive moisture, and to compressive stresses exceeding 100 psi.

Some variation will be found in all tables of mortar quantities. This is due to the weights per cubic foot that have been used as a basis. Cement, lime and sand will usually vary some from the standard weights customarily used. The more accurate method of proportioning mortar is by weight, but for the convenience of the estimator, proportions in Table 8 are given by both weight and *volume.*

In the above table, cement is assumed as one bag equal to one cu. ft. and weighing 94 lbs. Hydrated lime is assumed at 40 lbs. per cu. ft. and 50 lbs. to the bag. Sand has been based on average conditions, in which a cubic foot of loose, damp sand, as normally used in construction, contains approximately 80 lbs. of dry sand.

This table assumes the use of hydrated lime in its dry form. If lime is to be used in the form of putty, the following information will be of assistance in computing the quantities of pulverized quicklime, lump quicklime or hydrated lime required to produce *one* cubic foot of lime putty:

Pulverized quicklime .... 25 lbs.

Lump quicklime .... 28.5 lbs.

Hydrated lime .... 43.5 lbs.

Examples

Problem 1. Estimate the quantity of standard modular brick and mortar required in 800 sq. ft. of 12-in. solid brick wall with 4 in. of facing brick laid with ⅜-in. joints and 8 in. of backup brick laid with ½-in. joints. The wall will be laid in common bond with continuous full headers every 7th course and with Type B mortar.

Facing Brick

Table 1—800 x 6.75	5400
Table 3—Add 1/7 x 5400	771
	6171
Add 5% for breakage	309
Total number facing brick	6480

Backup Brick

Table 2—800 x 13.5	10,800
Table 3—Deduct 1/7 x 5400	771
	10,029
Add 5% for breakage	501
Total number of backup brick	10,530

Mortar

Table 1, for 3/8-in. joints in facing 800 x .0608	48.64 cu. ft.
Table 2, for ½-in. joints in back up 800 x .1988	159.04 cu. ft.
Table 2, for 7/16-in. collar joint and ½-in. collar joint 8 x (3.65 + 4.17)	62.56 cu. ft.
Total mortar required	270.24 cu. ft.

Table 8—271 cu. ft. of Type B mortar requires:

Cement	271 x .163 =	44.17 cu. ft.
Hydrated Lime	271 x .163 =	44.17 cu. ft.
Sand	271 x .983 =	266.00 cu. ft.

Problem 2. Same as Problem 1, except that 8 x 8 x 12-in. horizontal cell, flat bed, backup tile are used in place of 8-in. of backup brick. Tile will be laid with ½-in. joints and full bed joints.

Facing Brick

Same as Problem 1	6480

Backup Brick

Some common brick will be required to back up the facing brick headers which occur every 7th course.

5400 x 1/7	771
Add 5% for breakage	39
Total number of backup brick	810

Backup Tile

Since 1/7 of the area of the backup will be brick the remaining 6/7 will be tile.

6/7 x 800 = 686 sq. ft.

Table 4

686 x 1.5	1029
Add 2% for breakage	21
Total number of backup tile	1050

Mortar

Facing Brick (same as in Problem 1)	48.64 cu. ft.
Backup Brick Table 1—.771 x 11.3	8.71 cu. ft.
Backup Tile Table 4—686 x .0474	32.52 cu. ft.
Collar Joint (from Table 2 for 7/16-in. collar joint) 8 x 3.65	29.20 cu. ft.
Total volume of mortar required	119.07 cu. ft.

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Technical Notes ON BRICK & TILE CONSTRUCTION

STRUCTURAL CLAY PRODUCTS INSTITUTE

CLEANING CLAY PRODUCTS MASONRY

INTRODUCTION

The problems involved in the cleaning of clay products masonry are, as in the general subject of cleaning, dependent on the nature of both the surface to be cleaned and the material to be removed. There are, however, three general classifications into which the cleaning problems fall, each of which may be considered individually.

1. Removal of mortar and mortar stains on the wall surfaces of new construction or such dirt as might normally be deposited during construction and which should be removed prior to final inspection of the work.
2. Cleaning the exterior surfaces of older structures, particularly those in areas where the atmosphere is affected by industrial activities, and whose walls may develop an unattractive appearance due to a gradual deposition of soot and dirt.
3. Cleaning necessary to remove discolorations due to staining from metallic or organic substances, paint, etc., where, as a rule, relatively small areas are affected and which may require rather special treatment.

As previously mentioned, the process used in cleaning depends on the type of masonry units as well as the nature or composition of the discoloration. For instance, different problems are encountered with walls of unglazed units than with glazed products and a satisfactory method for one type may not be at all suitable for the other. An additional factor common to all clay product masonry walls is that some cleaning agents, which have no damaging effect but are quite effective on the burned clay units, may be quite injurious to the mortar in the masonry joints. Rough textured units are obviously more difficult to clean than those having smooth surfaces. To prevent the necessity of removing the surface to such a depth as would result in an appearance significantly or undesirably different from the original, special precautions must be taken to prevent penetration of the pores by discoloring material when cleaning walls of highly absorptive units.

CLEANING NEW CONSTRUCTION

In the construction of masonry walls, a skilled mason will generally keep the surface remarkably free from mortar particles and stains. However, in modern construction, where speed in erection is of much importance, even the most skilled mason will find it difficult, if not impossible, to keep his work entirely free from such stains. For this reason, most specifications require a final washing down of all masonry work. Typical methods and requirements are as follows:

Unglazed Masonry Surfaces. On completion of the work all masonry must be carefully cleaned, removing all large particles of mortar with a putty knife or chisel. Where the removal of mortar stains requires the use of acid (see note below), it is recommended that muriatic (hydrochloric) acid no stronger than one part of commercial acid to nine parts water by volume be used. Before the acid solution is applied, the surface should be thoroughly soaked with clear water, otherwise the mortar stain may be drawn into the pores causing a permanent dulling of the natural masonry colors. The acid solution should be applied with a long-handled, stiff fiber brush, with proper precautions as to covering of clothing, hands and arms to prevent burns. It should not be placed over an area greater than 15 to 20 square feet before the wall is again thoroughly washed down, or preferably hosed, with clear water immediately after cleaning. It is important to remove all trace of the acid before it attacks the mortar joints. All frames, trim, sills, or other installations adjacent to the masonry must be carefully protected against contact with the acid solution.

Note: Whenever possible, smooth, light-colored units should be scrubbed with soap and warm water in lieu of acid cleaning.

Glazed Surfaces. Acid cleaning is not recommended for glazed tile masonry. As the work progresses, any excess mortar should be removed with a cloth. Upon completion of the work, all wall surfaces of glazed units may be cleaned, using soap and warm water applied with a fiber

scrubbing brush, followed by a thorough rinsing with clear water. Hard lumps of mortar may be removed by using sharpened wooden paddles. Metal cleaning tools and brushes or abrasive powders should not be used.

CLEANING EXISTING MASONRY

The principal methods of cleaning older masonry structures are sand blasting, steam or steam-and-water jet, and by the application of cleaning compounds. The first two of these are used principally on large buildings as considerable equipment is necessary for either method. Cleaning compounds may be applied to either large or small structures.

Sand Blasting. Sand blasting consists of blowing hard sand through a nozzle by compressed air against the surface to be cleaned. The sand removes a thin layer from the wall surface, the thickness of the layer depending upon the depth to which dirt or stain may have penetrated the wall. This method is an effective process; however, it destroys the original texture of the unit and leaves the wall with a coarse texture which is particularly susceptible to the accumulation of soot and dirt. Due to the difference in hardness between clay units and the mortar joints, sand blasting may do serious damage to the joints.

If sand blasting is used it will frequently be necessary to repoint the mortar joints after the surface has been cleaned; the application of a colorless waterproofing compound to the roughened surface will tend to make the wall self-cleansing, and will prevent the rapid soiling of the surface from smoke and dust particles in the air. Sand blasting should never be used on glazed ware or other units having special surfaces or textures.

Steam or Steam-and-Water Jets. This method of cleaning consists of washing the wall with a steam or steam-and-water jet under pressure. It is effective in removing soot and dirt which accumulate on a wall over a period of time. Best results are obtained when it is used on glazed ware or low absorption units; however, it has also been used with fair success on high absorption or rough textured units. It is not effective in removing stains which have penetrated into the pores nor in removing such substances as mortar or paint.

Frequently an alkali salt, such as sodium carbonate, sodium bicarbonate or tri-sodium phosphate, is added to the cleaning water when the cleaning is done by the jet method. While these compounds aid materially in the cleaning action, some of the salt will be retained in the clay unit (the amount depending largely upon the absorption of the unit) and may appear later on the face of the wall in the form of efflorescence. The amount of the salt retained by the clay units can be materially reduced by thoroughly wetting the surface with clear water before the cleaning solution is applied. The wall should also be washed with an abundance of clear water after cleaning to remove the salt from the surface.

Application of Cleaning Compounds. This method is applicable to structures of all sizes and is probably used to a greater extent than any of the other methods. On large projects the cleaning contractor develops a cleaning compound best adapted to the particular job. This is done through an examination and analysis of the material and stains to be removed, and the strength and chemical composition of the solution is usually adjusted by trial. Some of the more common types of stains and recommended methods of removal are discussed later in this bulletin.

Many cleaning solutions contain compounds which, if absorbed by the clay units, will subsequently appear on the face of the wall in the form of efflorescence. For this reason, the surface to be cleaned should be thoroughly wetted with clear water before the cleaning solution is applied as well as being rinsed with clear water after the application.

Removing Efflorescence. The term efflorescence generally refers to a white powdery substance sometimes seen on masonry wall surfaces. It is composed of one or more water soluble salts which were originally present in the masonry materials, carried to the surface by movement of water which had entered the wall and deposited on the surface on evaporation of the water. It can frequently be removed by water applied with a stiff scrubbing brush. In those cases where this procedure does not remove all the efflorescence, the surface should be scrubbed with a solution of muriatic (hydrochloric) acid not stronger than one part of the commercial acid to nine parts water by volume. It is highly important that the recommendation regarding water rinsing of the wall, *both* before and after acid washing, be followed. It is sometimes desirable to give the surface a final washing with water containing approximately 5 per cent household ammonia.

Note: For a more detailed discussion of efflorescence, see Technical Notes on Brick & Tile Construction, Vol. 1, No. 2, February, 1950.

Occasionally a green stain will apear on buff or gray facing brick or tile. This may be a form of efflorescence resulting from vanadium or molybdenum compounds in the clay unit. *Hydrochloric acid should not be used in attempting to remove efflorescence resulting from such compounds.* The acid may react with the vanadium or molybdenum compounds, converting them to an insoluble brown stain that is practically impossible to remove, other than with abrasives. A cleaning method that has been used successfully in many such cases is to wash the wall with a solution of caustic soda, such as one part "Drano" to ten parts water. Here again, the wall should be washed with clear water, both before and after the application of the caustic soda solution, and precautions taken to protect the clothing and skin of the person using the solution.

TREATMENT FOR REMOVAL OF STAINS

The treatment of stains on clay products masonry is one in which a discoloring material of more or less definite composition is treated with a cleaning agent suitable only for that particular case. Such treatments are not always successful and many cases require persistent and repeated efforts. The stains listed are usually present in small localized wall areas and are thus susceptible to treatment by these methods which sometimes are rather tedious.

Mortar Stains. The method described previously for washing down unglazed masonry wall surfaces after construction is also used for the removal of mortar particles and stains on existing work.

Paint Stains. For fresh paint apply a commercial paint remover, or a solution of tri-sodium phosphate in water—two pounds of tri-sodium phosphate to one gallon of water. Allow to stand and remove paint with scraper and wire brush. Wash with clear water.

For very old dried paint, organic solvents similar to the above may not be effective, in which case the paint must be removed by sand blasting or scrubbing with steel wool.

Iron Stains. Mix seven parts lime-free glycerine with a solution of one part sodium citrate in six parts lukewarm water, and mix with whiting or kieselguhr to make a thick paste. Apply paste to stain with trowel, and scrape off when dried out. Repeat until stain has disappeared and wash thoroughly with clear water.

A poultice made from a solution of sodium hydrosulphite and an inert powder (such as talc) has also been used for the removal of iron rust stains.

Tobacco Stains. Dissolve two pounds of tri-sodium phosphate in five quarts of water. In separate vessel make a smooth stiff paste of 12 ounces of chloride of lime in water. Pour the former into the paste and stir thoroughly. Make a stiff paste of this with powdered talc and apply in the same way as described above for iron stains.

Smoke Stains. Make smooth stiff paste of trichlorethylene and powdered talc and apply as described above. Cover with glass or pan to prevent rapid evaporation. If slight stain is left after several applications, wash thoroughly and then use the method described under tobacco stains. Precaution should be taken to ventilate a closed space in which trichlorethylene is used, as the fumes are harmful.

Soap and water applied with a stiff bristle brush are frequently effective in removing soot and coal smoke stains. A small amount of powdered pumice added to the soap solution may increase its effectiveness.

Copper or Bronze Stains. Mix together in the dry form one part of ammonium chloride (sal ammoniac) and four parts of powdered talc. Add ammonia water and stir until a thick paste is obtained. Place this over the stain and leave until dry. When working on glazed tile use a wooden paddle to scrape off the paste. An old stain of this kind may require several applications. Sometimes aluminum chloride is used in the above procedure instead of the sal ammoniac.

Oil Stains. Make a paste of a solution of one pound of tri-sodium phosphate to one gallon of water and whiting which may be obtained at any paint store. Spread this paste in a layer about one-half inch thick over the surface to be cleaned and leave it until it dries (approximately 24 hours). Remove the paste and wash surface with clear water.

An alternate treatment consists of the application of a poultice made by adding powdered talc or whiting to a five per cent solution of caustic soda.

Plant Growth. Occasionally an exterior masonry surface which is not exposed to sunlight and remains in a constantly damp condition will exhibit signs of a plant growth such as moss. Application of ammonium sulfamate (marketed under the manufacturer's brand name and available in gardening supply stores) according to di-

rections furnished with the compound, has been used successfully in the removal of such growths. While it is not believed an unsightly residue would be left on the face of the wall, any powdery deposit could be removed by washing with water.

CLEANING GLAZED UNITS

Since the surface of glazed units is normally impervious to penetration by liquids, an existing wall of such ware would not be expected to present as much of a cleaning problem as one of more absorptive units. Etching of the glaze by acid or alkali attack or marring of the surface by abrasion constitute the main sources of possible damage resulting from improper use of cleaning agents. A cleansing with soap and water is frequently quite satisfactory. The use of soft water is preferable and, if not available, hard water may be softened by the addition of tri-sodium phosphate or one of several available packaged household products sold for that purpose.

More stubborn discolorations may usually be removed by a *gentle* scrubbing with a household scouring powder. It is advisable to avoid this more severe treatment if possible, mainly because the amount and hardness of the abrading grit used in these powders varies. In any event, a small area should first be cleaned and the surface examined for possible scratching before extending the area of operations.

Sodium hydrosulphite, acidified sodium fluosilicate, and ammonium bifluoride have been used effectively with glazed ware and if sufficiently diluted are not apt to etch the glaze. The cleaning solution should be prepared by adding one-half to three-quarter pound of any one of the above to one gallon of water. When using these compounds all metal and glass should be protected from the cleaning solution, the cleaner mixed in wooden containers and, in applying it, rubber gloves used to protect the hands. A thorough rinsing of the surface with clear water should follow the use of any of these compounds.

REFERENCES

"A Study of the Problems Relating to the Maintenance of Interior Marble" by D. W. Kessler, Technologic Paper No. 350, National Bureau of Standards.

"Removing Stains from Cast Stone and Concrete" by R. E. Baumgarten, Concrete Building and Concrete Products, Vol. 12, No. 3, March 1937.

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Technical Notes ON BRICK & TILE CONSTRUCTION VOL. 1 NO. 2 FEBRUARY 1950

STRUCTURAL CLAY PRODUCTS INSTITUTE

EFFLORESCENCE

INTRODUCTION

Efflorescence in masonry construction is used to designate the white powdery substance that often appears on the surface of walls.

The appearance of efflorescence on a masonry wall should be a matter of concern since it is an indication that unwanted moisture is present within the wall itself. Such moisture, if permitted to continue to collect, will, under certain conditions, eventually contribute to the deterioration of the masonry. Too often it is regarded only as an unsightly nuisance without realizing that its appearance is evidence of a fault in design or workmanship that should be corrected.

CAUSES OF EFFLORESCENCE

Efflorescence on brick or tile masonry walls is usually a light powder, or crystallization, caused by water soluble salts, deposited on the surface upon evaporation of the water. Some of the salts frequently found in efflorescence are calcium sulfate (gypsum), magnesium sulfate (epsom salts), sodium chloride (table salt), sodium sulfate and potassium sulfate. There are two general conditions necessary to produce efflorescence: (1) soluble salts present in the materials used to construct the wall, and (2) moisture in sufficient quantities to carry these salts to the surface.

Soluble salts may be present in the masonry units, mortar or plaster. However, tests at the Bureau of Standards on several hundred samples of brick from all over the United States, ranging from well-burned to under-burned, indicated that 83% of the samples would *not* be a source of efflorescence. If these results were weighted according to production, it is probable that the figures would indicate that fully 90% of the production of structural clay products in this country would be free of soluble salts in sufficient quantities to cause efflorescence. What, then, is the source of the efflorescence so commonly observed on many masonry buildings?

Second-hand brick, because of its uncertain origin and previous contact with mortar or plaster, may frequently be a source of efflorescence when re-used in new construction. Certain masonry units, other than structural clay units, usually contain soluble salts and may be a source. The ingredients used in mortar and plaster often contain soluble salts and are frequently the cause of efflorescence. Portland cements contain soluble salts as do some limes, sands and even mixing waters.

When efflorescence first appears on a wall, it may be possible by observation to determine the source. If it appears only at the edges of the masonry unit, it is probably the mortar that contains the soluble salts, and not the masonry unit. If the efflorescence covers the entire unit, it is likely that *both* the mortar and masonry units are the source. Efflorescence appearing near the center and not near the edges of the unit indicates that the units themselves probably contain soluble salts and are the cause. While such observations are often valuable guides in determining the source of efflorescence, only the testing of all the materials can provide an accurate answer as to whether soluble salts are present in sufficient quantities to cause efflorescence. For example, the wick test for efflorescence in building brick is included in "Standard Methods of Sampling and Testing Brick", ASTM Designation C67-. This test consists essentially in standing the whole brick to be tested on end in approximately 1 inch of distilled water, kept at a constant level, for 7 days. The brick is then oven dried and compared with an untreated brick to estimate the amount of efflorescence.

There is, as yet (1950), no standard method developed for the testing of mortars or mortar materials for efflorescence. In an attempt to improve this situation, a Subcommittee on Efflorescence of ASTM Committee C-12 on Masonry Mortars, was formed several years ago and has been studying the problem. Although much helpful information has been obtained, no test method has been found that is fully satisfactory.

In connection with the efflorescing of mortars or mortar materials, there has been in recent years an increasing interest in the possibility of using barium carbonate as an admixture to mortars to eliminate or minimize efflorescence from that

source. There is evidence that the use of barium carbonate in quantities theoretically capable of reacting with such soluble sulfates as calcium and magnesium sulfate, converting them to carbonates, effectively decreases or eliminates efflorescence from those sources. Although laboratory tests indicate that the use of barium carbonate may be helpful in preventing efflorescence, there is not, at present, sufficient significant data available to make possible specific recommendations as to the optimum quantity of barium required. The lack of a recognized and nationally accepted standard test method for the determination of efflorescence from mortar materials has prevented a universal acceptance of such data on the use of barium carbonate as are now available.

Since the presence of moisture in sufficient quantities to carry the soluble salts to the wall surface is the second general condition necessary to produce efflorescence, the correction of such a condition must, of course, also include an investigation to determine how and where such moisture enters. Although the presence of moisture is almost always caused by some fault in construction, such may not be the case when a uniform coating of efflorescence appears on a newly constructed building. Too often an excess amount of water is used during construction which, in the process of gradual evaporation, will carry any soluble salts that may be present to the wall surface. If the building is well designed and constructed, a final cleaning, or sometimes a few rains, will wash away the efflorescence and it will seldom appear again.

If, however, the efflorescence persists in appearing, it is evident that moisture is continuing to penetrate the wall and steps should be taken to determine the source of trouble and correct it. Defective flashings (or the lack of flashings at vulnerable spots), gutters and downspouts, faulty copings or improperly filled mortar joints may, either singly, or in combination, be the cause of wet walls.

Water which enters a wall may not always leave at the same spot. Therefore, the location of the efflorescence does not necessarily mean that water is entering the wall at that point. However, the location of the efflorescence frequently provides a clue to the source of trouble. For example, efflorescence streaking down from the top of a wall, or patches some distance from the top, would indicate defective copings, gutters, or roof flashings. The appearance of efflorescence under windows is evidence that the sills or caulking around the window frame should be investigated. A single patch of efflorescence on a wall, with no apparent relation to masonry openings, copings, gutters, etc., may be the result of a defective mortar joint or a projecting course of masonry forming a water table. If it appears on the foundation wall close to the ground, especially when rather porous units have been used, it could be caused by ground water drawn up by capillary suction. In every case, the general principle is that this spot of efflorescence indicates a portion of the wall unduly wetted.

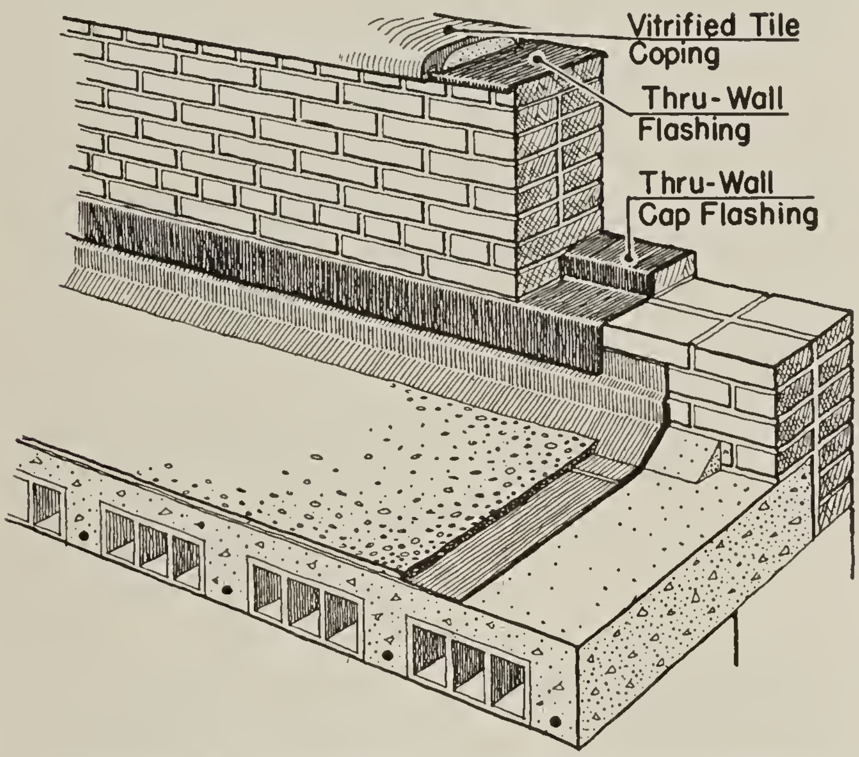
Typical example of efflorescence caused by water entering the wall through a coping not properly flashed. Faulty roof flashing could also be the cause of efflorescence appearing in such a location as shown here.

CORRECTION OF CONSTRUCTION FAULTS

If, after such inspection, the cause or causes of the wet walls are apparent, steps should be taken to correct the faults before the efflorescence is removed. Otherwise it will likely reappear in the future. Faulty flashings, gutters and downspouts should be repaired. If the copings are at fault, they should be taken up and relaid with thin, but well-filled mortar joints with rodded tooling. Non-corrosive metal or bituminous flashing should be placed directly under copings, cornices, chimney caps, sills and any projecting courses of masonry.

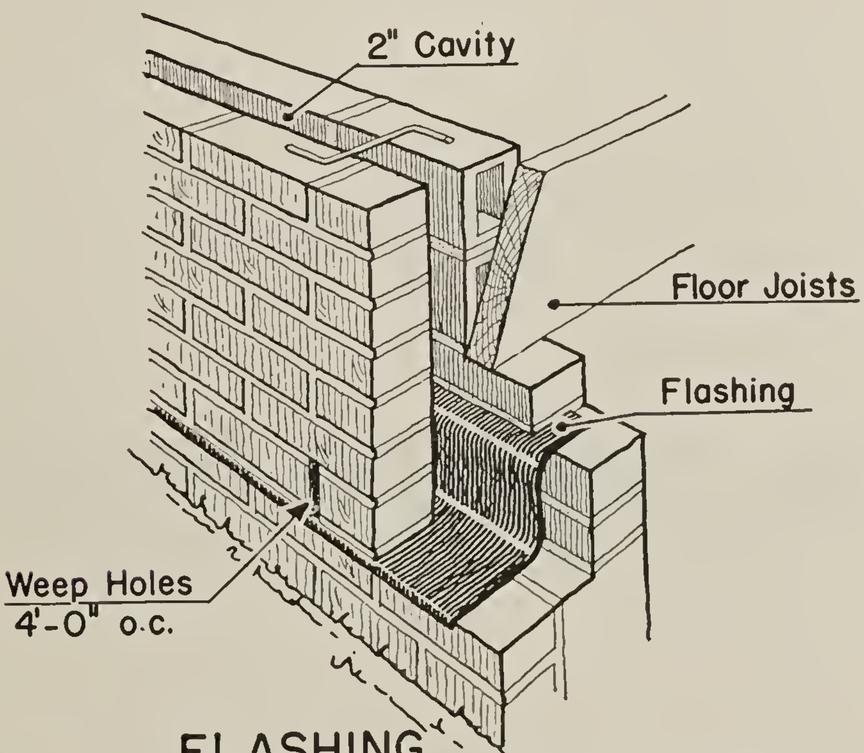
Improperly filled mortar joints in exposed walls should be raked out and repointed with a plastic mortar of approximately the same mix as used in the original work. In order to eliminate as much of the original shrinkage as possible, the tuck-pointing mortar should be pre-hydrated by mixing with only a portion of the mixing water one or two hours before using, after which it may be remixed with sufficient added water to produce satisfactory workability. The use of cement, lime, sand or water which might tend to cause effloresc-

cence should be avoided. If the caulking around door or window frames was completely omitted, all such cracks should be filled with a good elastic caulking compound placed with a pressure gun. If the original caulking has become dried out, cracked, peeled or separated, it should be removed and replaced with new compound under pressure. Raking and repointing the mortar joints in sills may also be necessary.



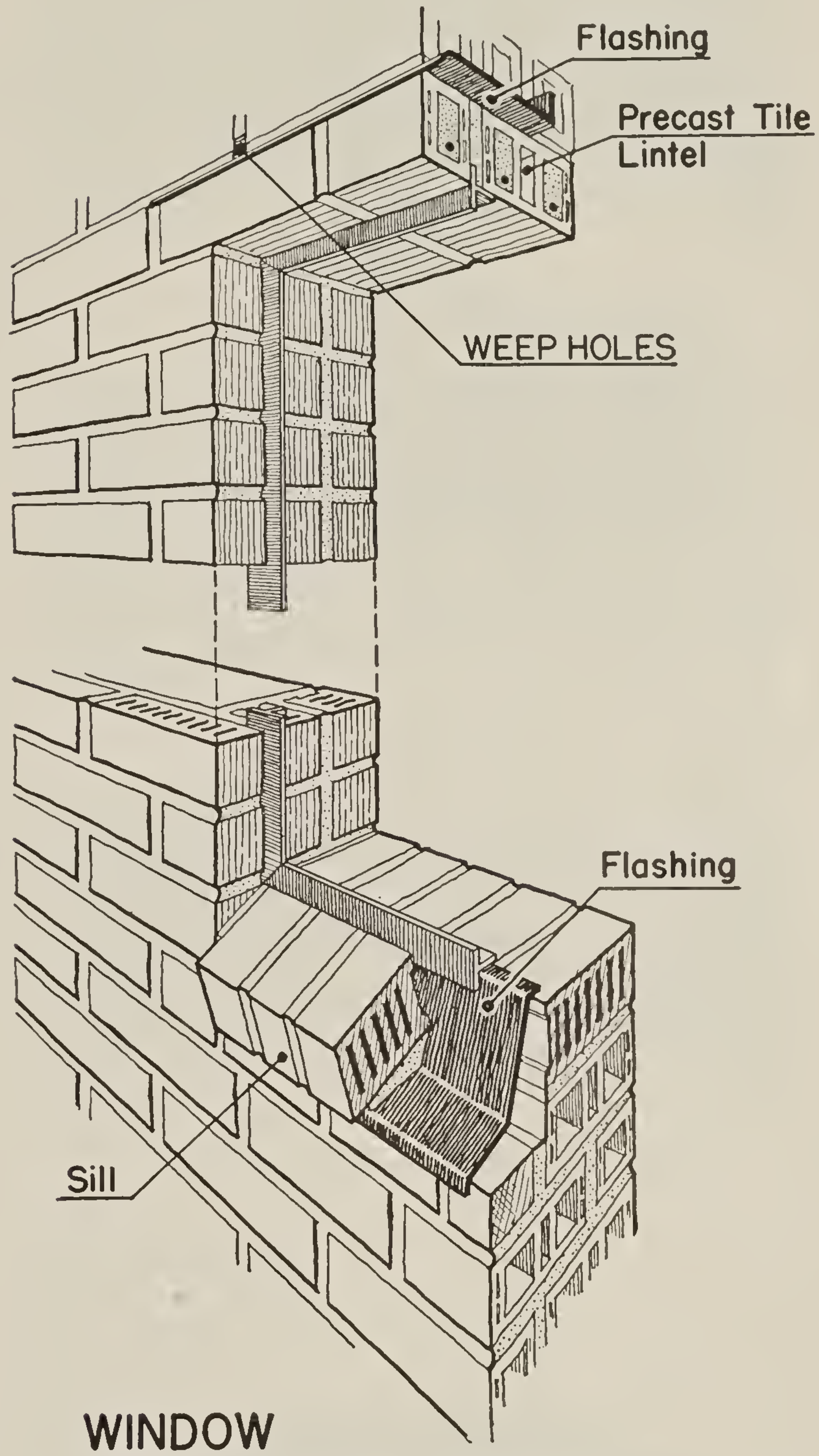
ROOF & PARAPET WALL FLASHING

Dampness in foundation and lower parts of walls above grade may be caused by lack of, or faulty: (1) footing drains, (2) dampproofing on outside of foundation walls, and (3) dampproofing in masonry course immediately above grade.

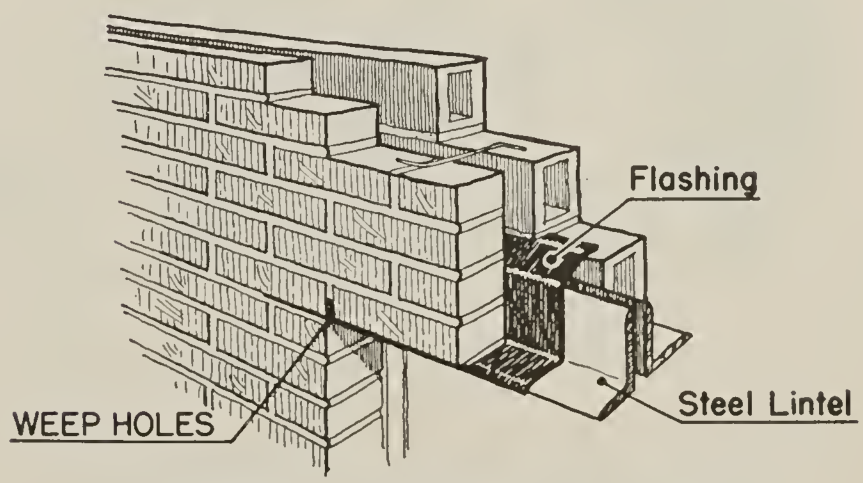


FLASHING BOTTOM OF CAVITY WALL

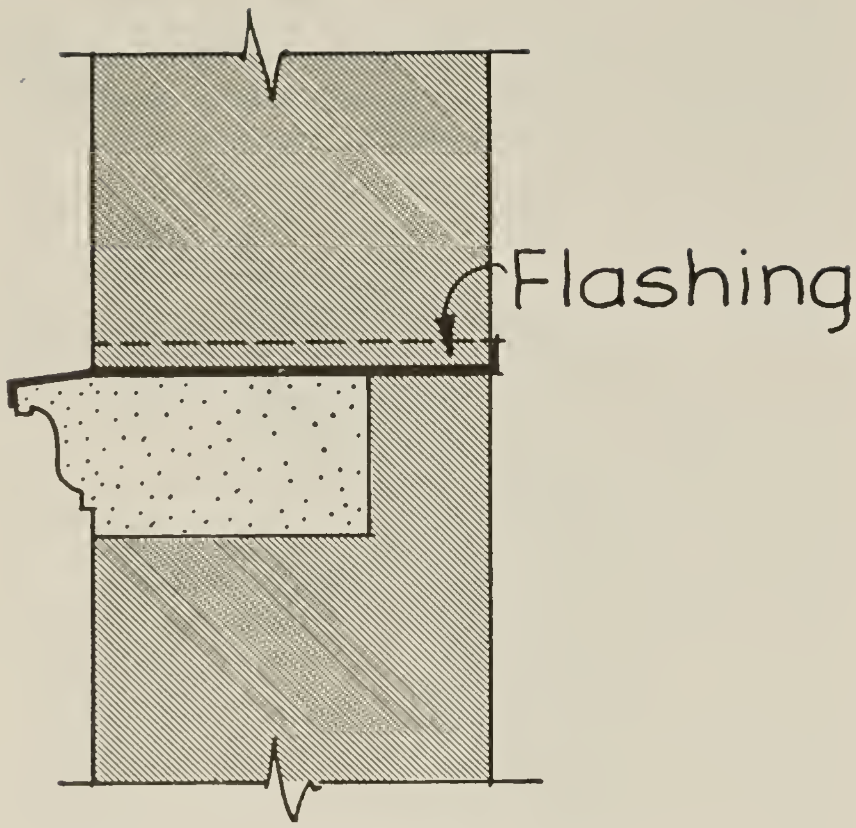
Causes (1) and (2) may be corrected after construction, although at considerable expense, but a dampproof membrane is practically impossible to insert after a wall is built.



WINDOW HEAD & SILL FLASHING



FLASHING OVER STEEL LINTEL



PROJECTION

REMOVING EFFLORESCENCE

With watertight walls and good flashing installations, efflorescence which appears on the walls soon after the building is erected, or repaired, will quite often disappear after several rains. If not, water applied with a stiff scrubbing brush will frequently do the job. If either of the above two procedures does not completely remove the efflorescence, the wall should be wetted, then scrubbed with water containing not more than one part of muriatic (hydrochloric) acid to nine parts water. Immediately thereafter, the wall should be thoroughly rinsed with plain water. It is very important that the recommendation regarding water rinsing of the wall *both* before and after acid washing be followed. All frames, trim, sills or other installations adjacent to the masonry should be carefully protected against contact with the acid solution. The workman should protect his exposed skin from contact with the acid solution and it is recommended that he wear rubber gloves. It is also sometimes desirable to give the surface a final washing with water containing approximately 5% of household ammonia.

SUMMARY

To sum up, efflorescence in masonry construction is evidence of the use of materials containing soluble salts along with design and workmanship which permit excess water to enter the wall. It can be prevented by the use of suitable materials, proper design and good workmanship. The choice of materials has been discussed somewhat, but *more* emphasis should be placed on design and workmanship. It should be remembered that a correct design and good workmanship constitute the best insurance against future efflorescence.

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PHILADELPHIA 40, PA.
BAldwin 3-7800

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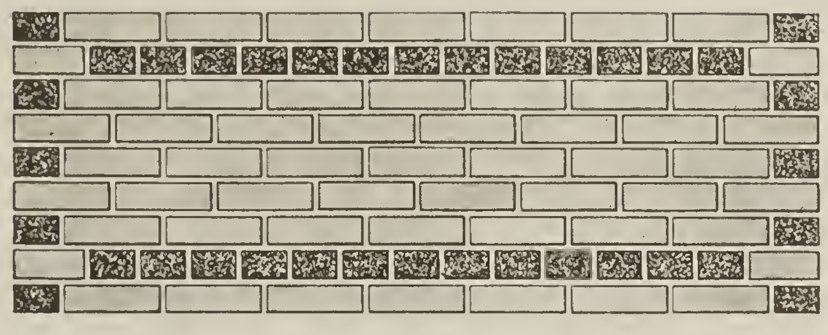
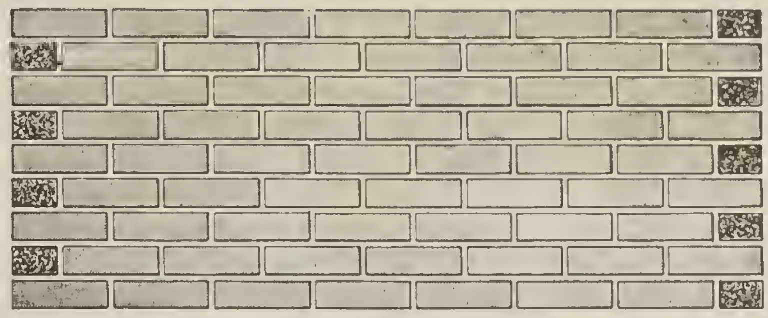
REpublic 9-2600

150 MacQuesten Parkway, So.
MOUNT VERNON, N. Y.
MOunt Vernon 8-3500
FAirbanks 4-5800

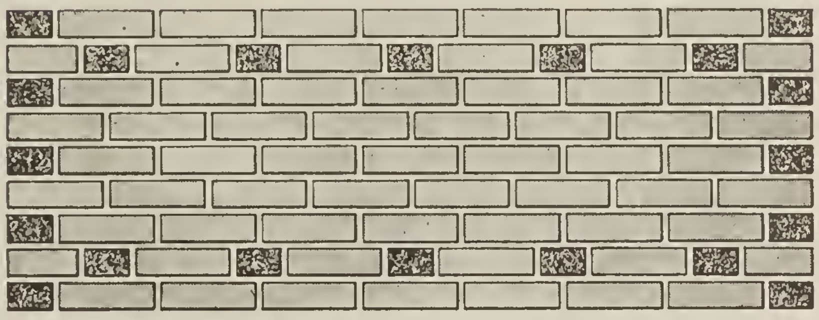
BRICK BONDS



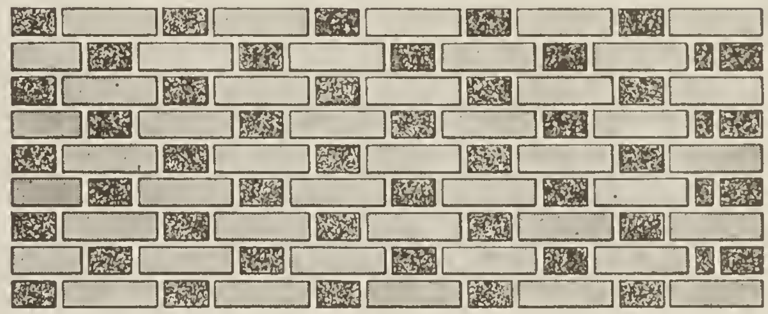
COMMON BOND
Full Headers Every 6th Course



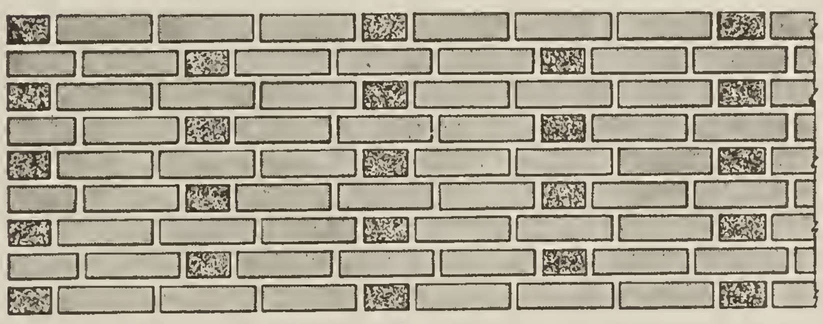
RUNNING BOND



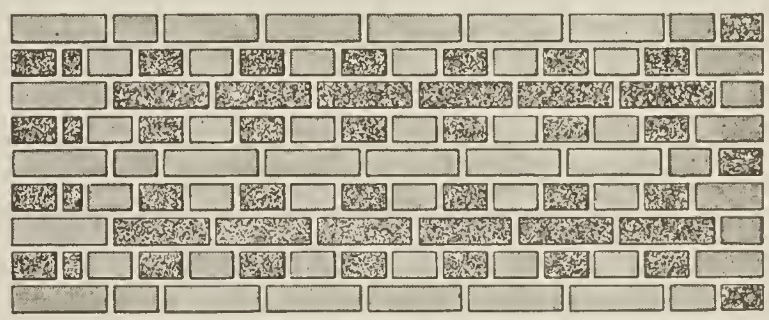
COMMON BOND
Flemish Headers Every 6th Course



DUTCH CORNER ENGLISH CORNER
FLEMISH BOND



GARDEN WALL BOND



ENGLISH CORNER DUTCH CORNER
ENGLISH CROSS OR DUTCH BOND

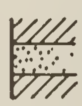
Brick Bonds

The above illustrations are the most popular of Brick Bonds. The use of Soldier and Rowlock courses, together with Herringbone and Basket Weave patterns can produce an unlimited variety of wall effects. Recessed brick panels or courses, as well as protruding brick panels or courses, can develop interesting patterns and textures of a wall. Mortar joints, their finish, depth, color and texture are an open field for resourcefulness. Brickwork with its many variations is a challenge to the architect's imagination.

Mortar Joints


Weathered—Slant joint upward.


Raked—Tool after raking out.


Flush—Smooth with trowel.


Vee—Excellent waterproof joint.


Concave—Most common joint.


Beaded—Requires skill to do well.


Struck—Not recommended.

Specifications

Facing Brick	(ASTM Designation: C216-)
Building Brick	(ASTM Designation: C62-)
Portland Cement	(ASTM Designation: C150-)
Masonry Cement	(ASTM Designation: C91-)
Quicklime	(ASTM Designation: C5-)
Hydrated Lime	(ASTM Designation: C207-)
Aggregates	(ASTM Designation: C144-)

"Tomkins for the usual and unusual in Face Brick"

VOL. 1 NO. 2 FEBRUARY 1950

Technical Notes ON BRICK & TILE CONSTRUCTION

STRUCTURAL CLAY PRODUCTS INSTITUTE

EFFLORESCENCE

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A. I. A. FILE NO. 5-M

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Since the presence of moisture in sufficient quantities to carry the soluble salts to the wall surface is the second general condition necessary to produce efflorescence, the correction of such a condition must, of course, also include an investigation to determine how and where such moisture enters. Although the presence of moisture is almost always caused by some fault in construction, such may not be the case when a uniform coating of efflorescence appears on a newly constructed building. Too often an excess amount of water is used during construction which, in the process of gradual evaporation, will carry any soluble salts that may be present to the wall surface. If the building is well designed and constructed, a final cleaning, or sometimes a few rains, will wash away the efflorescence and it will seldom appear again.

If, however, the efflorescence persists in appearing, it is evident that moisture is continuing to penetrate the wall and steps should be taken to determine the source of trouble and correct it. Defective flashings (or the lack of flashings at vulnerable spots), gutters and downspouts, faulty copings or improperly filled mortar joints may, either singly, or in combination, be the cause of wet walls.

Water which enters a wall may not always leave at the same spot. Therefore, the location of the efflorescence does not necessarily mean that water is entering the wall at that point. However, the location of the efflorescence frequently provides a clue to the source of trouble. For example, efflorescence streaking down from the top of a wall, or patches some distance from the top, would indicate defective copings, gutters, or roof flashings. The appearance of efflorescence under windows is evidence that the sills or caulking around the window frame should be investigated. A single patch of efflorescence on a wall, with no apparent relation to masonry openings, copings, gutters, etc., may be the result of a defective mortar joint or a projecting course of masonry forming a water table. If it appears on the foundation wall close to the ground, especially when rather porous units have been used, it could be caused by ground water drawn up by capillary suction. In every case, the general principle is that this spot of efflorescence indicates a portion of the wall unduly wetted.

Typical example of efflorescence caused by water entering the wall through a coping not properly flashed. Faulty roof flashing could also be the cause of efflorescence appearing in such a location as shown here.

CORRECTION OF CONSTRUCTION FAULTS

If, after such inspection, the cause or causes of the wet walls are apparent, steps should be taken to correct the faults before the efflorescence is removed. Otherwise it will likely reappear in the future. Faulty flashings, gutters and downspouts should be repaired. If the copings are at fault, they should be taken up and relaid with thin, but well-filled mortar joints with rodded tooling. Non-corrosive metal or bituminous flashing should be placed directly under copings, cornices, chimney caps, sills and any projecting courses of masonry.

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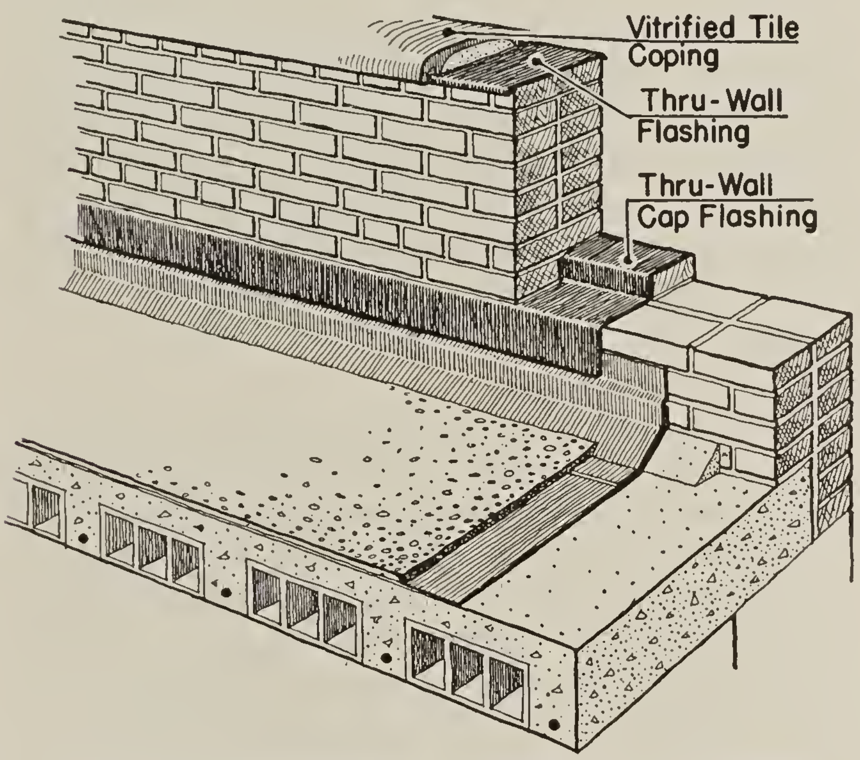

ROOF & PARAPET WALL FLASHING

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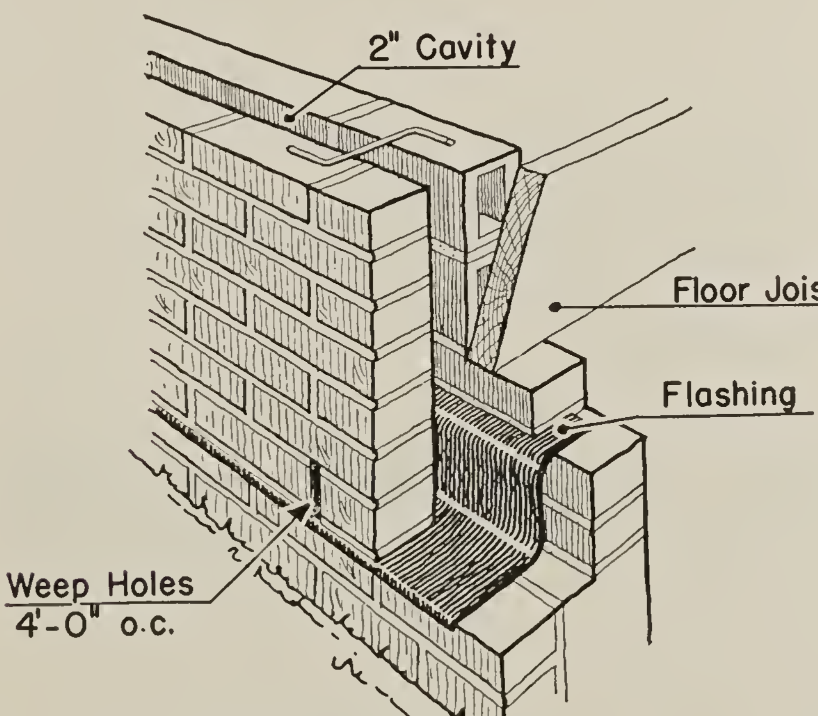
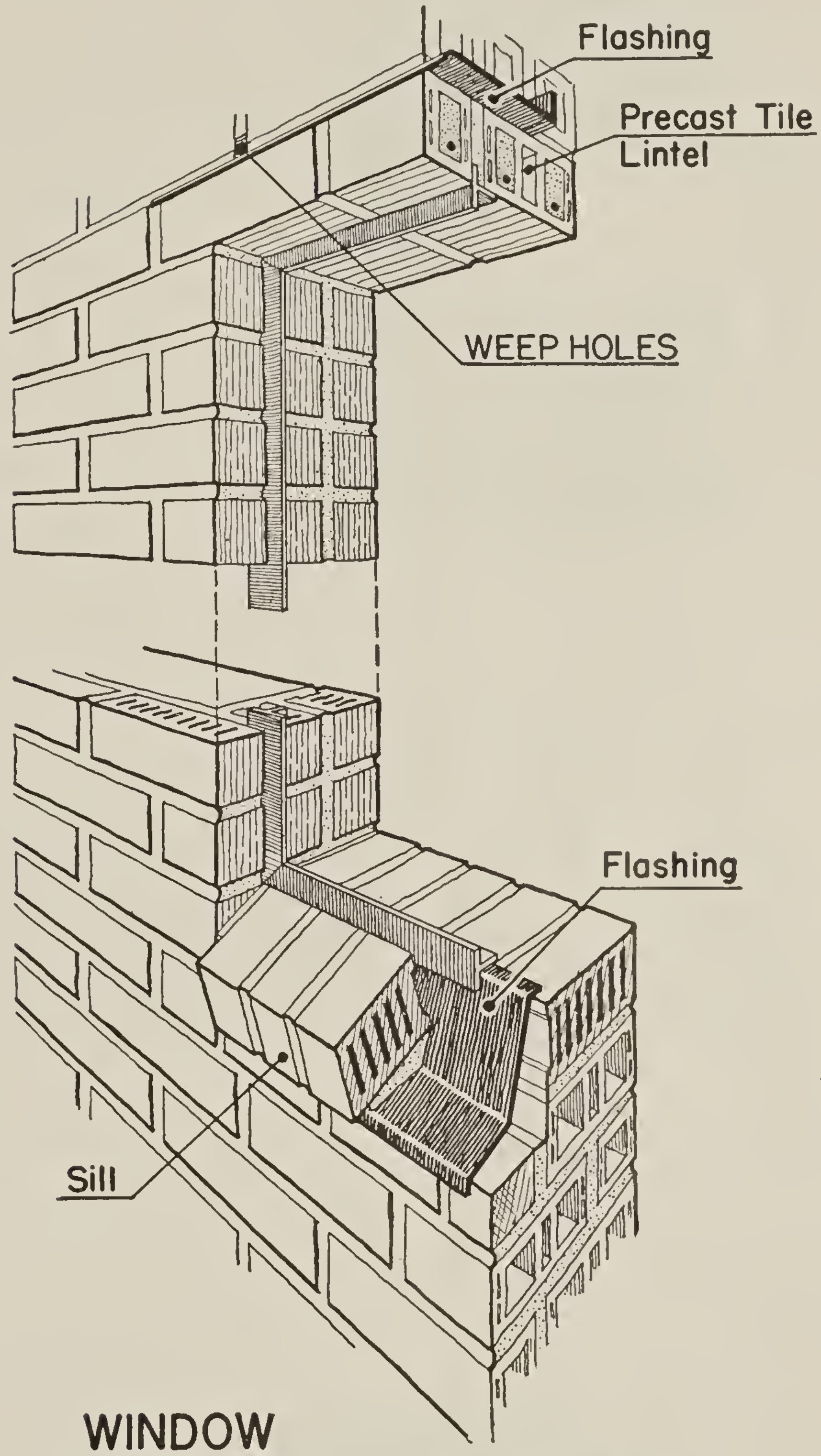
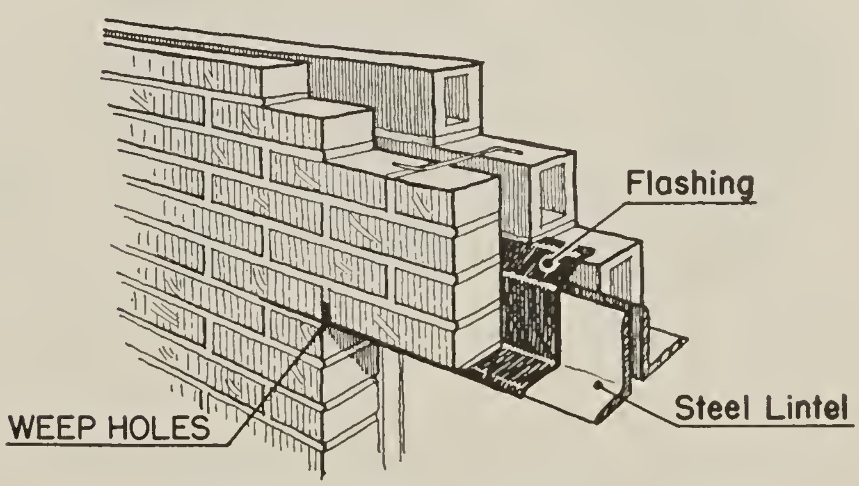


FLASHING BOTTOM OF CAVITY WALL

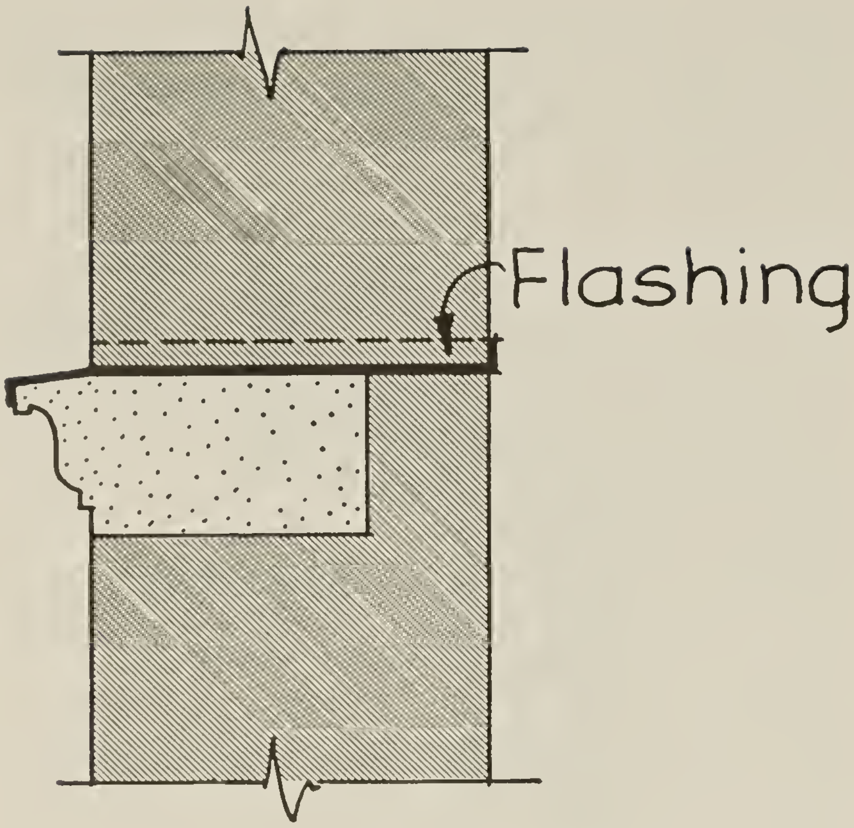
Causes (1) and (2) may be corrected after construction, although at considerable expense, but a dampproof membrane is practically impossible to insert after a wall is built.



WINDOW HEAD & SILL FLASHING



FLASHING OVER STEEL LINTEL



PROJECTION

REMOVING EFFLORESCENCE

With watertight walls and good flashing installations, efflorescence which appears on the walls soon after the building is erected, or repaired, will quite often disappear after several rains. If not, water applied with a stiff scrubbing brush will frequently do the job. If either of the above two procedures does not completely remove the efflorescence, the wall should be wetted, then scrubbed with water containing not more than one part of muriatic (hydrochloric) acid to nine parts water. Immediately thereafter, the wall should be thoroughly rinsed with plain water. It is very important that the recommendation regarding water rinsing of the wall *both* before and after acid washing be followed. All frames, trim, sills or other installations adjacent to the masonry should be carefully protected against contact with the acid solution. The workman should protect his exposed skin from contact with the acid solution and it is recommended that he wear rubber gloves. It is also sometimes desirable to give the surface a final washing with water containing approximately 5% of household ammonia.

SUMMARY

To sum up, efflorescence in masonry construction is evidence of the use of materials containing soluble salts along with design and workmanship which permit excess water to enter the wall. It can be prevented by the use of suitable materials, proper design and good workmanship. The choice of materials has been discussed somewhat, but *more* emphasis should be placed on design and workmanship. It should be remembered that a correct design and good workmanship constitute the best insurance against future efflorescence.

A. I. A. FILE NO. 5-A-1

Technical Notes ON BRICK & TILE CONSTRUCTION

VOL. 1 NO. 5 MAY 1950

STRUCTURAL CLAY PRODUCTS INSTITUTE

CLEANING CLAY PRODUCTS MASONRY

INTRODUCTION

The problems involved in the cleaning of clay products masonry are, as in the general subject of cleaning, dependent on the nature of both the surface to be cleaned and the material to be removed. There are, however, three general classifications into which the cleaning problems fall, each of which may be considered individually.

1. Removal of mortar and mortar stains on the wall surfaces of new construction or such dirt as might normally be deposited during construction and which should be removed prior to final inspection of the work.
2. Cleaning the exterior surfaces of older structures, particularly those in areas where the atmosphere is affected by industrial activities, and whose walls may develop an unattractive appearance due to a gradual deposition of soot and dirt.
3. Cleaning necessary to remove discolorations due to staining from metallic or organic substances, paint, etc., where, as a rule, relatively small areas are affected and which may require rather special treatment.

As previously mentioned, the process used in cleaning depends on the type of masonry units as well as the nature or composition of the discoloration. For instance, different problems are encountered with walls of unglazed units than with glazed products and a satisfactory method for one type may not be at all suitable for the other. An additional factor common to all clay product masonry walls is that some cleaning agents, which have no damaging effect but are quite effective on the burned clay units, may be quite injurious to the mortar in the masonry joints. Rough textured units are obviously more difficult to clean than those having smooth surfaces. To prevent the necessity of removing the surface to such a depth as would result in an appearance significantly or undesirably different from the original, special precautions must be taken to prevent penetration of the pores by discoloring material when cleaning walls of highly absorptive units.

CLEANING NEW CONSTRUCTION

In the construction of masonry walls, a skilled mason will generally keep the surface remarkably free from mortar particles and stains. However, in modern construction, where speed in erection is of much importance, even the most skilled mason will find it difficult, if not impossible, to keep his work entirely free from such stains. For this reason, most specifications require a final washing down of all masonry work. Typical methods and requirements are as follows:

Unglazed Masonry Surfaces. On completion of the work all masonry must be carefully cleaned, removing all large particles of mortar with a putty knife or chisel. Where the removal of mortar stains requires the use of acid (see note below), it is recommended that muriatic (hydrochloric) acid no stronger than one part of commercial acid to nine parts water by volume be used. Before the acid solution is applied, the surface should be thoroughly soaked with clear water, otherwise the mortar stain may be drawn into the pores causing a permanent dulling of the natural masonry colors. The acid solution should be applied with a long-handled, stiff fiber brush, with proper precautions as to covering of clothing, hands and arms to prevent burns. It should not be placed over an area greater than 15 to 20 square feet before the wall is again thoroughly washed down, or preferably hosed, with clear water immediately after cleaning. It is important to remove all trace of the acid before it attacks the mortar joints. All frames, trim, sills, or other installations adjacent to the masonry must be carefully protected against contact with the acid solution.

Note: Whenever possible, smooth, light-colored units should be scrubbed with soap and warm water in lieu of acid cleaning.

Glazed Surfaces. Acid cleaning is not recommended for glazed tile masonry. As the work progresses, any excess mortar should be removed with a cloth. Upon completion of the work, all wall surfaces of glazed units may be cleaned, using soap and warm water applied with a fiber

A. I. A. FILE NO. 5-A-1

scrubbing brush, followed by a thorough rinsing with clear water. Hard lumps of mortar may be removed by using sharpened wooden paddles. Metal cleaning tools and brushes or abrasive powders should not be used.

CLEANING EXISTING MASONRY

The principal methods of cleaning older masonry structures are sand blasting, steam or steam-and-water jet, and by the application of cleaning compounds. The first two of these are used principally on large buildings as considerable equipment is necessary for either method. Cleaning compounds may be applied to either large or small structures.

Sand Blasting. Sand blasting consists of blowing hard sand through a nozzle by compressed air against the surface to be cleaned. The sand removes a thin layer from the wall surface, the thickness of the layer depending upon the depth to which dirt or stain may have penetrated the wall. This method is an effective process; however, it destroys the original texture of the unit and leaves the wall with a coarse texture which is particularly susceptible to the accumulation of soot and dirt. Due to the difference in hardness between clay units and the mortar joints, sand blasting may do serious damage to the joints.

If sand blasting is used it will frequently be necessary to repoint the mortar joints after the surface has been cleaned; the application of a colorless waterproofing compound to the roughened surface will tend to make the wall self-cleansing, and will prevent the rapid soiling of the surface from smoke and dust particles in the air. Sand blasting should never be used on glazed ware or other units having special surfaces or textures.

Steam or Steam-and-Water Jets. This method of cleaning consists of washing the wall with a steam or steam-and-water jet under pressure. It is effective in removing soot and dirt which accumulate on a wall over a period of time. Best results are obtained when it is used on glazed ware or low absorption units; however, it has also been used with fair success on high absorption or rough textured units. It is not effective in removing stains which have penetrated into the pores nor in removing such substances as mortar or paint.

Frequently an alkali salt, such as sodium carbonate, sodium bicarbonate or tri-sodium phosphate, is added to the cleaning water when the cleaning is done by the jet method. While these compounds aid materially in the cleaning action, some of the salt will be retained in the clay unit (the amount depending largely upon the absorption of the unit) and may appear later on the face of the wall in the form of efflorescence. The amount of the salt retained by the clay units can be materially reduced by thoroughly wetting the surface with clear water before the cleaning solution is applied. The wall should also be washed with an abundance of clear water after cleaning to remove the salt from the surface.

Application of Cleaning Compounds. This method is applicable to structures of all sizes and is probably used to a greater extent than any of the other methods. On large projects the cleaning contractor develops a cleaning compound best adapted to the particular job. This is done through an examination and analysis of the material and stains to be removed, and the strength and chemial composition of the solution is usually adjusted by trial. Some of the more common types of stains and recommended methods of removal are discussed later in this bulletin.

Many cleaning solutions contain compounds which, if absorbed by the clay units, will subsequently appear on the face of the wall in the form of efflorescence. For this reason, the surface to be cleaned should be thoroughly wetted with clear water before the cleaning solution is applied as well as being rinsed with clear water after the application.

Removing Efflorescence. The term efflorescence generally refers to a white powdery substance sometimes seen on masonry wall surfaces. It is composed of one or more water soluble salts which were originally present in the masonry materials, carried to the surface by movement of water which had entered the wall and deposited on the surface on evaporation of the water. It can frequently be removed by water applied with a stiff scrubbing brush. In those cases where this procedure does not remove all the efflorescence, the surface should be scrubbed with a solution of muriatic (hydrochloric) acid not stronger than one part of the commercial acid to nine parts water by volume. It is highly important that the recommendation regarding water rinsing of the wall, *both* before and after acid washing, be followed. It is sometimes desirable to give the surface a final washing with water containing approximately 5 per cent household ammonia.

Note: For a more detailed discussion of efflorescence, see Technical Notes on Brick & Tile Construction, Vol. 1, No. 2, February, 1950.

Occasionally a green stain will apear on buff or gray facing brick or tile. This may be a form of efflorescence resulting from vanadium or molybdenum compounds in the clay unit. *Hydrochloric acid should not be used in attempting to remove efflorescence resulting from such compounds.* The acid may react with the vanadium or molybdenum compounds, converting them to an insoluble brown stain that is practically impossible to remove, other than with abrasives. A cleaning method that has been used successfully in many such cases is to wash the wall with a solution of caustic soda, such as one part "Drano" to ten parts water. Here again, the wall should be washed with clear water, both before and after the application of the caustic soda solution, and precautions taken to protect the clothing and skin of the person using the solution.

TREATMENT FOR REMOVAL OF STAINS

The treatment of stains on clay products masonry is one in which a discoloring material of more or less definite composition is treated with a cleaning agent suitable only for that particular case. Such treatments are not always successful and many cases require persistent and repeated efforts. The stains listed are usually present in small localized wall areas and are thus susceptible to treatment by these methods which sometimes are rather tedious.

Mortar Stains. The method described previously for washing down unglazed masonry wall surfaces after construction is also used for the removal of mortar particles and stains on existing work.

Paint Stains. For fresh paint apply a commercial paint remover, or a solution of tri-sodium phosphate in water—two pounds of tri-sodium phosphate to one gallon of water. Allow to stand and remove paint with scraper and wire brush. Wash with clear water.

For very old dried paint, organic solvents similar to the above may not be effective, in which case the paint must be removed by sand blasting or scrubbing with steel wool.

Iron Stains. Mix seven parts lime-free glycerine with a solution of one part sodium citrate in six parts lukewarm water, and mix with whiting or kieselguhr to make a thick paste. Apply paste to stain with trowel, and scrape off when dried out. Repeat until stain has disappeared and wash thoroughly with clear water.

A poultice made from a solution of sodium hydrosulphite and an inert powder (such as talc) has also been used for the removal of iron rust stains.

Tobacco Stains. Dissolve two pounds of tri-sodium phosphate in five quarts of water. In separate vessel make a smooth stiff paste of 12 ounces of chloride of lime in water. Pour the former into the paste and stir thoroughly. Make a stiff paste of this with powdered talc and apply in the same way as described above for iron stains.

Smoke Stains. Make smooth stiff paste of trichlorethylene and powdered talc and apply as described above. Cover with glass or pan to prevent rapid evaporation. If slight stain is left after several applications, wash thoroughly and then use the method described under tobacco stains. Precaution should be taken to ventilate a closed space in which trichlorethylene is used, as the fumes are harmful.

Soap and water applied with a stiff bristle brush are frequently effective in removing soot and coal smoke stains. A small amount of powdered pumice added to the soap solution may increase its effectiveness.

Copper or Bronze Stains. Mix together in the dry form one part of ammonium chloride (sal ammoniac) and four parts of powdered talc. Add ammonia water and stir until a thick paste is obtained. Place this over the stain and leave until dry. When working on glazed tile use a wooden paddle to scrape off the paste. An old stain of this kind may require several applications. Sometimes aluminum chloride is used in the above procedure instead of the sal ammoniac.

Oil Stains. Make a paste of a solution of one pound of tri-sodium phosphate to one gallon of water and whiting which may be obtained at any paint store. Spread this paste in a layer about one-half inch thick over the surface to be cleaned and leave it until it dries (approximately 24 hours). Remove the paste and wash surface with clear water.

An alternate treatment consists of the application of a poultice made by adding powdered talc or whiting to a five per cent solution of caustic soda.

Plant Growth. Occasionally an exterior masonry surface which is not exposed to sunlight and remains in a constantly damp condition will exhibit signs of a plant growth such as moss. Application of ammonium sulfamate (marketed under the manufacturer's brand name and available in gardening supply stores) according to di-

rections furnished with the compound, has been used successfully in the removal of such growths. While it is not believed an unsightly residue would be left on the face of the wall, any powdery deposit could be removed by washing with water.

CLEANING GLAZED UNITS

Since the surface of glazed units is normally impervious to penetration by liquids, an existing wall of such ware would not be expected to present as much of a cleaning problem as one of more absorptive units. Etching of the glaze by acid or alkali attack or marring of the surface by abrasion constitute the main sources of possible damage resulting from improper use of cleaning agents. A cleansing with soap and water is frequently quite satisfactory. The use of soft water is preferable and, if not available, hard water may be softened by the addition of tri-sodium phosphate or one of several available packaged household products sold for that purpose.

More stubborn discolorations may usually be removed by a *gentle* scrubbing with a household scouring powder. It is advisable to avoid this more severe treatment if possible, mainly because the amount and hardness of the abrading grit used in these powders varies. In any event, a small area should first be cleaned and the surface examined for possible scratching before extending the area of operations.

Sodium hydrosulphite, acidified sodium fluosilicate, and ammonium bifluoride have been used effectively with glazed ware and if sufficiently diluted are not apt to etch the glaze. The cleaning solution should be prepared by adding one-half to three-quarter pound of any one of the above to one gallon of water. When using these compounds all metal and glass should be protected from the cleaning solution, the cleaner mixed in wooden containers and, in applying it, rubber gloves used to protect the hands. A thorough rinsing of the surface with clear water should follow the use of any of these compounds.

REFERENCES

"A Study of the Problems Relating to the Maintenance of Interior Marble" by D. W. Kessler, Technologic Paper No. 350, National Bureau of Standards.

"Removing Stains from Cast Stone and Concrete" by R. E. Baumgarten, Concrete Building and Concrete Products, Vol. 12, No. 3, March 1937.

Technical Notes ON BRICK & TILE CONSTRUCTION

VOL. 1 NO. 2 FEBRUARY 1950

STRUCTURAL CLAY PRODUCTS INSTITUTE

EFFLORESCENCE

INTRODUCTION

Efflorescence in masonry construction is used to designate the white powdery substance that often appears on the surface of walls.

The appearance of efflorescence on a masonry wall should be a matter of concern since it is an indication that unwanted moisture is present within the wall itself. Such moisture, if permitted to continue to collect, will, under certain conditions, eventually contribute to the deterioration of the masonry. Too often it is regarded only as an unsightly nuisance without realizing that its appearance is evidence of a fault in design or workmanship that should be corrected.

CAUSES OF EFFLORESCENCE

Efflorescence on brick or tile masonry walls is usually a light powder, or crystallization, caused by water soluble salts, deposited on the surface upon evaporation of the water. Some of the salts frequently found in efflorescence are calcium sulfate (gypsum), magnesium sulfate (epsom salts), sodium chloride (table salt), sodium sulfate and potassium sulfate. There are two general conditions necessary to produce efflorescence: (1) soluble salts present in the materials used to construct the wall, and (2) moisture in sufficient quantities to carry these salts to the surface.

Soluble salts may be present in the masonry units, mortar or plaster. However, tests at the Bureau of Standards on several hundred samples of brick from all over the United States, ranging from well-burned to under-burned, indicated that 83% of the samples would *not* be a source of efflorescence. If these results were weighted according to production, it is probable that the figures would indicate that fully 90% of the production of structural clay products in this country would be free of soluble salts in sufficient quantities to cause efflorescence. What, then, is the source of the efflorescence so commonly observed on many masonry buildings?

Second-hand brick, because of its uncertain origin and previous contact with mortar or plaster, may frequently be a source of efflorescence when re-used in new construction. Certain masonry units, other than structural clay units, usually contain soluble salts and may be a source. The ingredients used in mortar and plaster often contain soluble salts and are frequently the cause of efflorescence. Portland cements contain soluble salts as do some limes, sands and even mixing waters.

When efflorescence first appears on a wall, it may be possible by observation to determine the source. If it appears only at the edges of the masonry unit, it is probably the mortar that contains the soluble salts, and not the masonry unit. If the efflorescence covers the entire unit, it is likely that *both* the mortar and masonry units are the source. Efflorescence appearing near the center and not near the edges of the unit indicates that the units themselves probably contain soluble salts and are the cause. While such observations are often valuable guides in determining the source of efflorescence, only the testing of all the materials can provide an accurate answer as to whether soluble salts are present in sufficient quantities to cause efflorescence. For example, the wick test for efflorescence in building brick is included in "Standard Methods of Sampling and Testing Brick", ASTM Designation C67-. This test consists essentially in standing the whole brick to be tested on end in approximately 1 inch of distilled water, kept at a constant level, for 7 days. The brick is then oven dried and compared with an untreated brick to estimate the amount of efflorescence.

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Since the presence of moisture in sufficient quantities to carry the soluble salts to the wall surface is the second general condition necessary to produce efflorescence, the correction of such a condition must, of course, also include an investigation to determine how and where such moisture enters. Although the presence of moisture is almost always caused by some fault in construction, such may not be the case when a uniform coating of efflorescence appears on a newly constructed building. Too often an excess amount of water is used during construction which, in the process of gradual evaporation, will carry any soluble salts that may be present to the wall surface. If the building is well designed and constructed, a final cleaning, or sometimes a few rains, will wash away the efflorescence and it will seldom appear again.

If, however, the efflorescence persists in appearing, it is evident that moisture is continuing to penetrate the wall and steps should be taken to determine the source of trouble and correct it. Defective flashings (or the lack of flashings at vulnerable spots), gutters and downspouts, faulty copings or improperly filled mortar joints may, either singly, or in combination, be the cause of wet walls.

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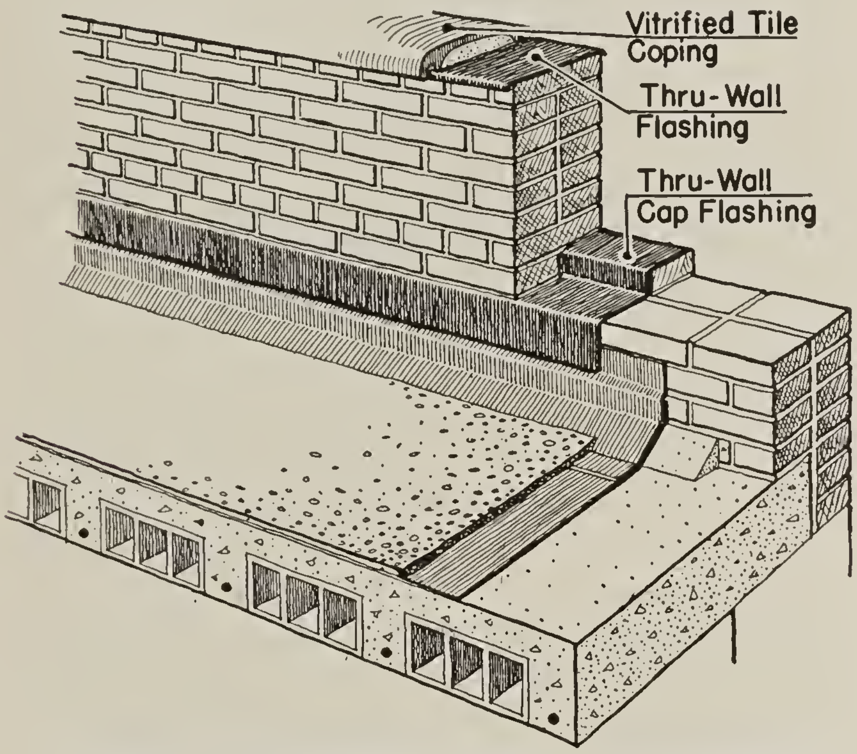
Typical example of efflorescence caused by water entering the wall through a coping not properly flashed. Faulty roof flashing could also be the cause of efflorescence appearing in such a location as shown here.

CORRECTION OF CONSTRUCTION FAULTS

If, after such inspection, the cause or causes of the wet walls are apparent, steps should be taken to correct the faults before the efflorescence is removed. Otherwise it will likely reappear in the future. Faulty flashings, gutters and downspouts should be repaired. If the copings are at fault, they should be taken up and relaid with thin, but well-filled mortar joints with rodded tooling. Non-corrosive metal or bituminous flashing should be placed directly under copings, cornices, chimney caps, sills and any projecting courses of masonry.

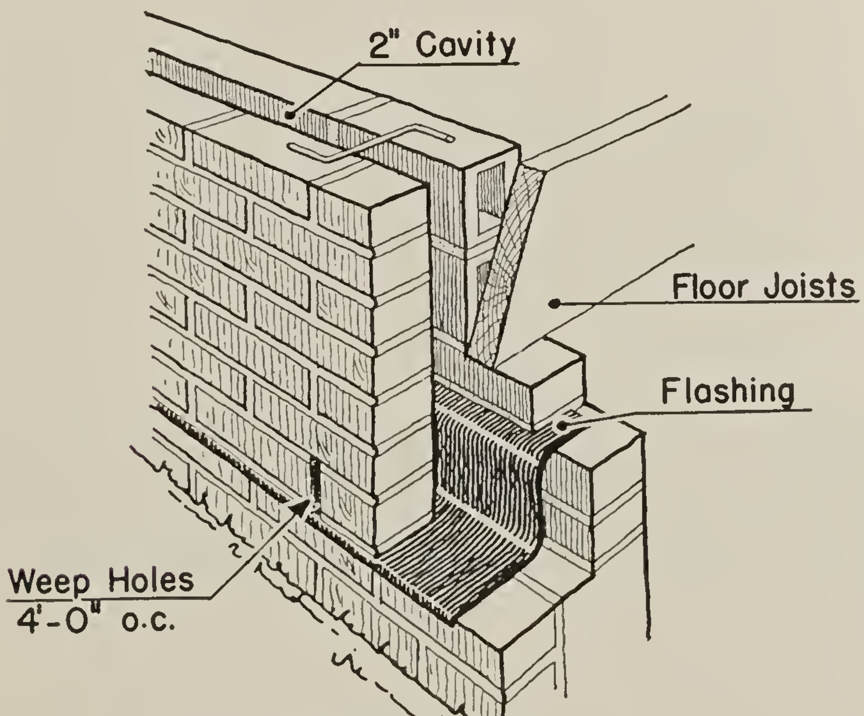
Improperly filled mortar joints in exposed walls should be raked out and repointed with a plastic mortar of approximately the same mix as used in the original work. In order to eliminate as much of the original shrinkage as possible, the tuck-pointing mortar should be pre-hydrated by mixing with only a portion of the mixing water one or two hours before using, after which it may be remixed with sufficient added water to produce satisfactory workability. The use of cement, lime, sand or water which might tend to cause efflores-

cence should be avoided. If the caulking around door or window frames was completely omitted, all such cracks should be filled with a good elastic caulking compound placed with a pressure gun. If the original caulking has become dried out, cracked, peeled or separated, it should be removed and replaced with new compound under pressure. Raking and repointing the mortar joints in sills may also be necessary.



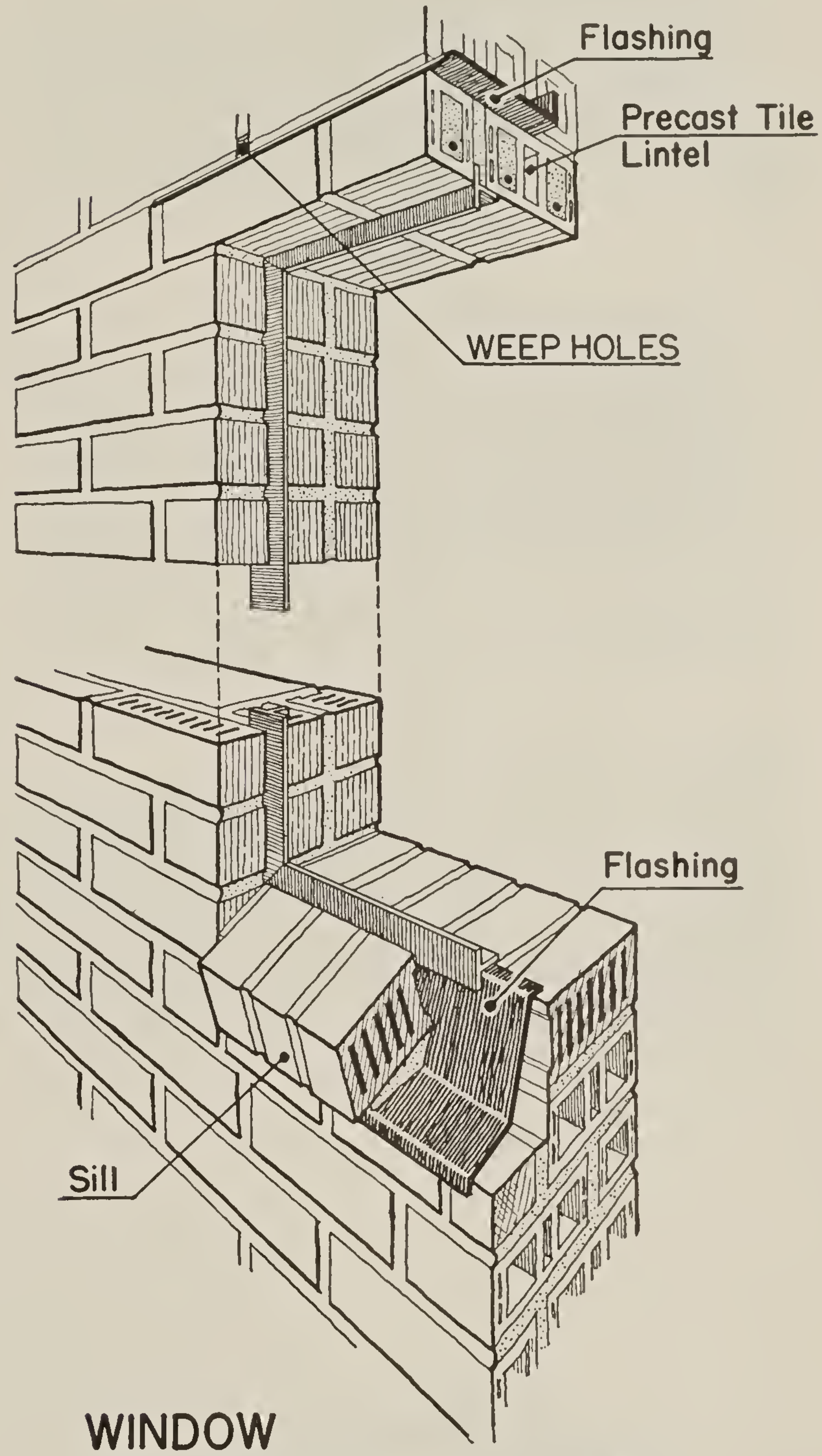
ROOF & PARAPET WALL FLASHING

Dampness in foundation and lower parts of walls above grade may be caused by lack of, or faulty: (1) footing drains, (2) dampproofing on outside of foundation walls, and (3) dampproofing in masonry course immediately above grade.

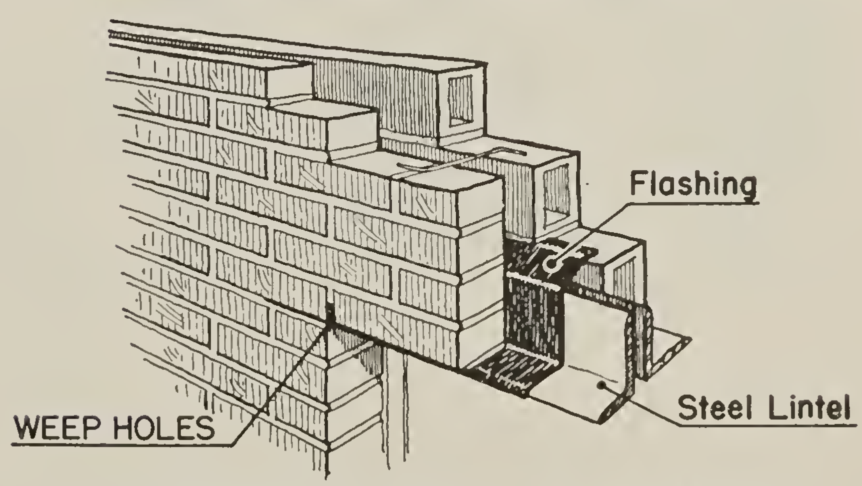


FLASHING BOTTOM OF CAVITY WALL

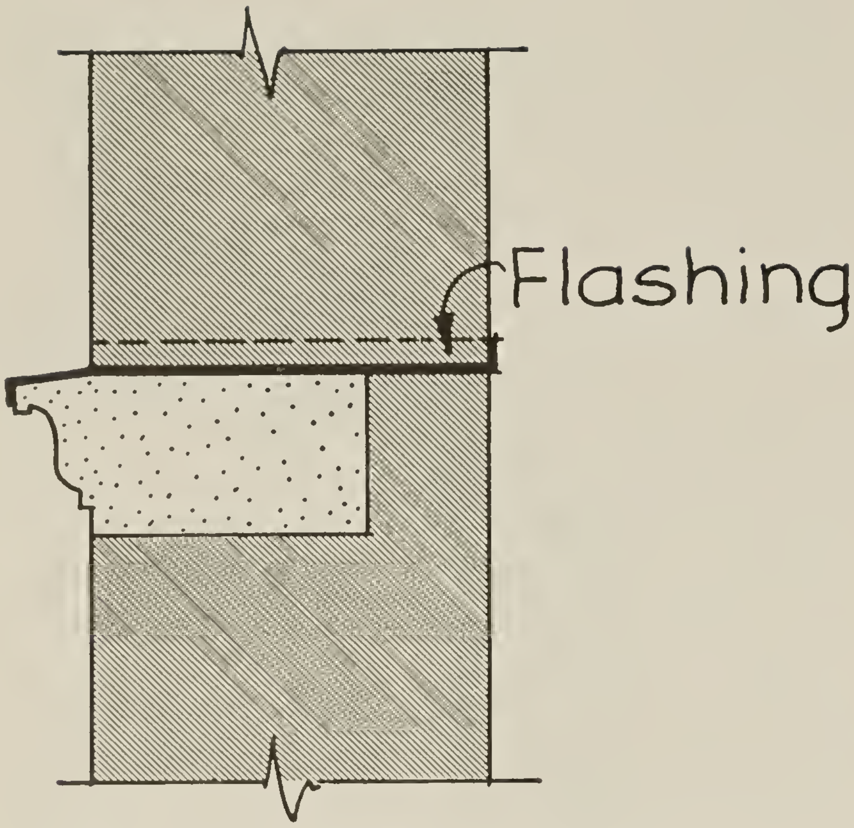
Causes (1) and (2) may be corrected after construction, although at considerable expense, but a dampproof membrane is practically impossible to insert after a wall is built.



WINDOW HEAD & SILL FLASHING



FLASHING OVER STEEL LINTEL



PROJECTION

REMOVING EFFLORESCENCE

With watertight walls and good flashing installations, efflorescence which appears on the walls soon after the building is erected, or repaired, will quite often disappear after several rains. If not, water applied with a stiff scrubbing brush will frequently do the job. If either of the above two procedures does not completely remove the efflorescence, the wall should be wetted, then scrubbed with water containing not more than one part of muriatic (hydrochloric) acid to nine parts water. Immediately thereafter, the wall should be thoroughly rinsed with plain water. It is very important that the recommendation regarding water rinsing of the wall *both* before and after acid washing be followed. All frames, trim, sills or other installations adjacent to the masonry should be carefully protected against contact with the acid solution. The workman should protect his exposed skin from contact with the acid solution and it is recommended that he wear rubber gloves. It is also sometimes desirable to give the surface a final washing with water containing approximately 5% of household ammonia.

SUMMARY

To sum up, efflorescence in masonry construction is evidence of the use of materials containing soluble salts along with design and workmanship which permit excess water to enter the wall. It can be prevented by the use of suitable materials, proper design and good workmanship. The choice of materials has been discussed somewhat, but *more* emphasis should be placed on design and workmanship. It should be remembered that a correct design and good workmanship constitute the best insurance against future efflorescence.

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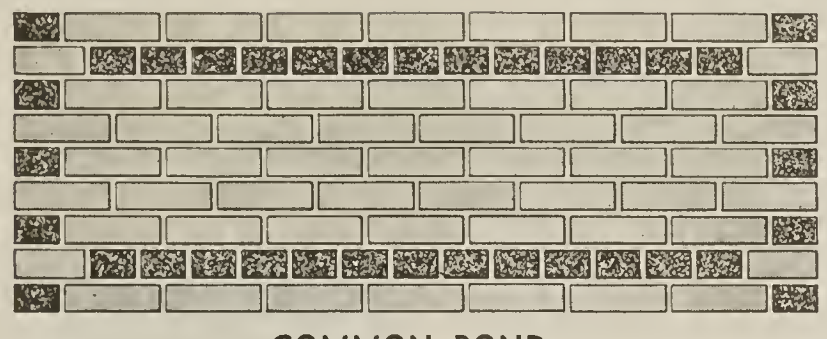
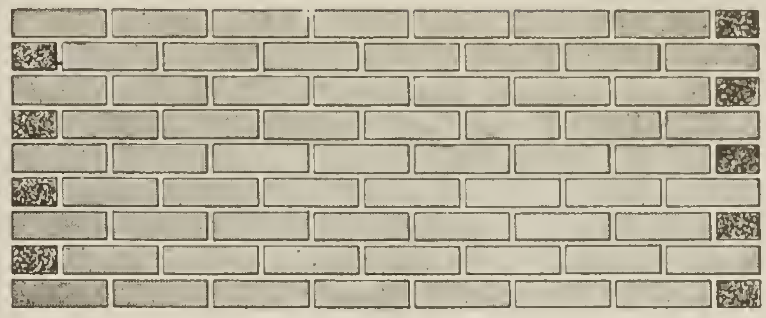
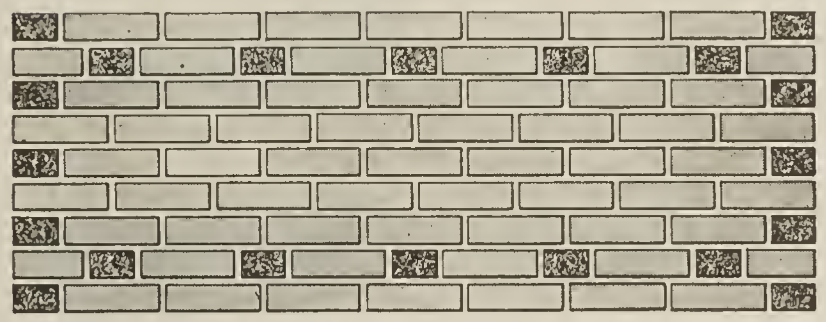
BRICK BONDS



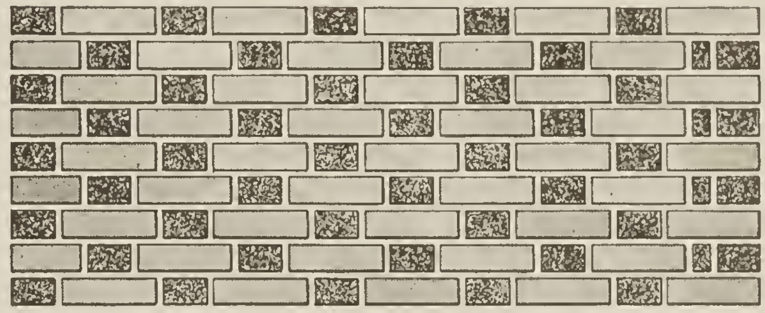
COMMON BOND
Full Headers Every 6th Course



RUNNING BOND

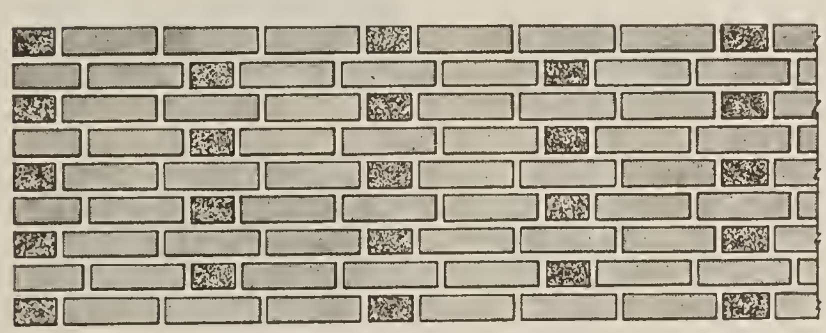


COMMON BOND
Flemish Headers Every 6th Course

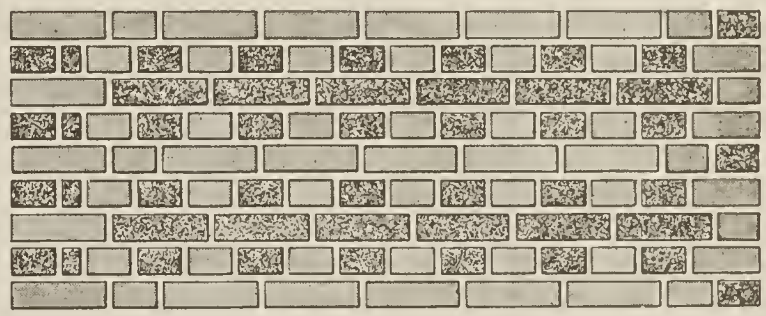


DUTCH CORNER — ENGLISH CORNER

FLEMISH BOND



GARDEN WALL BOND



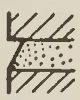
ENGLISH CORNER — DUTCH CORNER

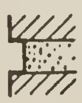
ENGLISH CROSS OR DUTCH BOND

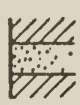
Brick Bonds

The above illustrations are the most popular of Brick Bonds. The use of Soldier and Rowlock courses, together with Herringbone and Basket Weave patterns can produce an unlimited variety of wall effects. Recessed brick panels or courses, as well as protruding brick panels or courses, can develop interesting patterns and textures of a wall. Mortar joints, their finish, depth, color and texture are an open field for resourcefulness. Brickwork with its many variations is a challenge to the architect's imagination.

Mortar Joints

 *Weathered*—Slant joint upward.

 *Raked*—Tool after raking out.

 *Flush*—Smooth with trowel.

 *Vee*—Excellent waterproof joint.

 *Concave*—Most common joint.

 *Beaded*—Requires skill to do well.

 *Struck*—Not recommended.

Specifications

Facing Brick	(ASTM Designation: C216-)
Building Brick	(ASTM Designation: C62-)
Portland Cement	(ASTM Designation: C150-)
Masonry Cement	(ASTM Designation: C91-)
Quicklime	(ASTM Designation: C5-)
Hydrated Lime	(ASTM Designation: C207-)
Aggregates	(ASTM Designation: C144-)

"Tomkins for the usual and unusual in Face Brick"

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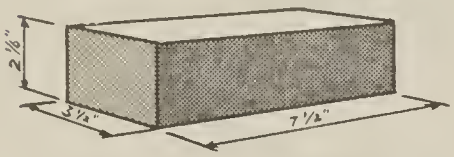
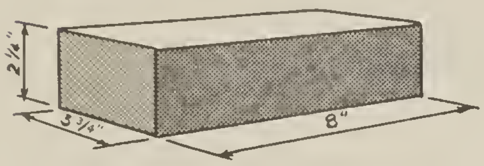
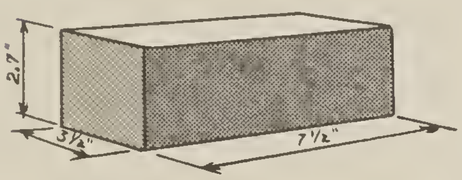
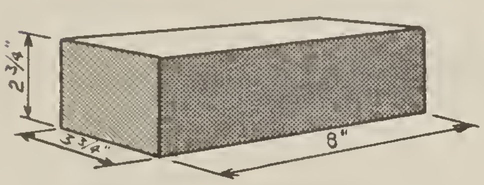
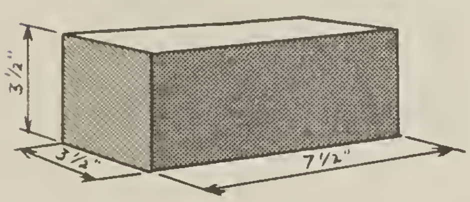
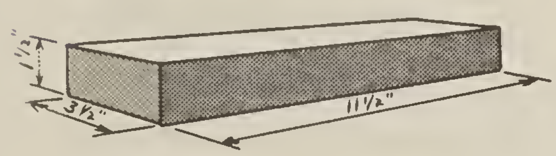
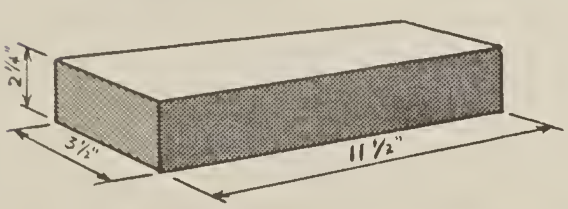
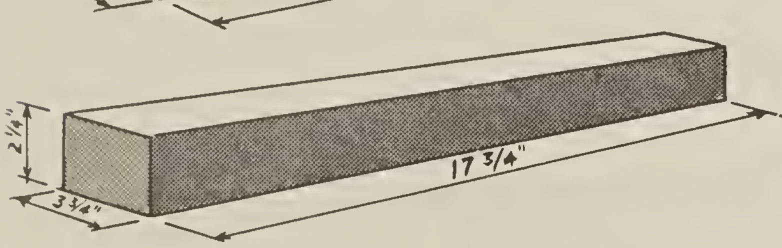
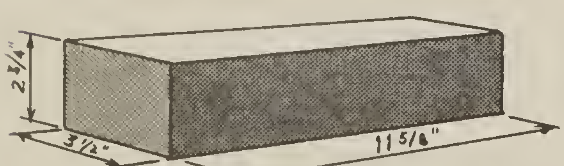
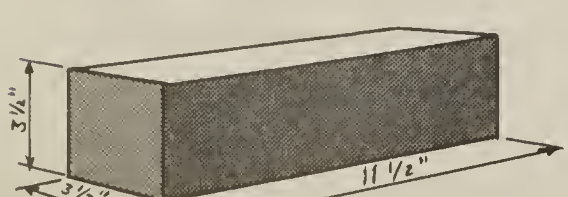
FACE BRICK SIZE COMPARISONS

All Sizes Manufactured in Buff, Grey, Tan & Red in a Wide Choice of Textures

		Displacement of 1000 Non-Modular Standard	% Saving of Brick
	MODULAR STANDARD	1095	-9.5
	NON MODULAR STANDARD	1000	----
	ENGINEER	913	8.7
	OVERSIZE	846	15.4
	ECONOMY 8"	730	27.
	ROMAN 11½" (May also be had in 15½")	974	2.6
	NORMAN	708	29.2
	MAGNOLIAN	466	53.4
	NORWEGIAN	593	40.7
	ECONOMY 12"	487	51.30

(ALL FIGURES BASED ON 1/2" JOINT)

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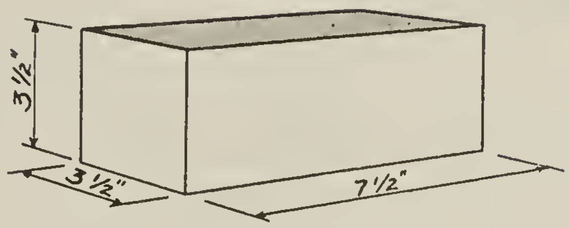
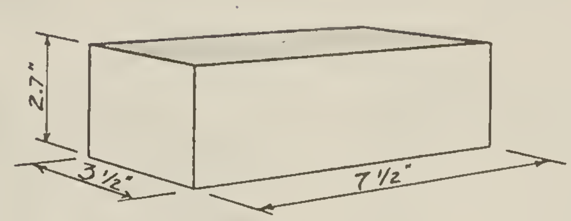
BRICK SIZES

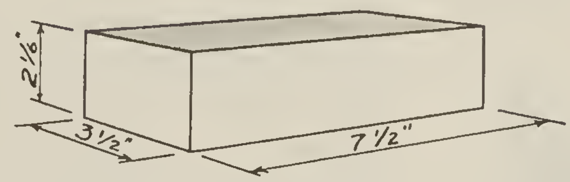
MODULAR BRICK



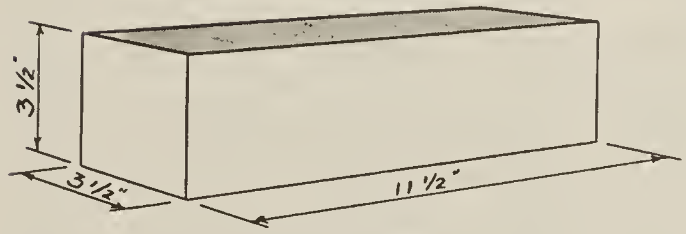
ECONOMY-8



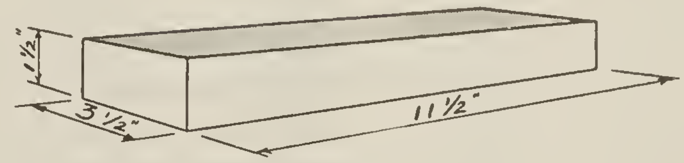
ENGINEER



STANDARD



ECONOMY-12

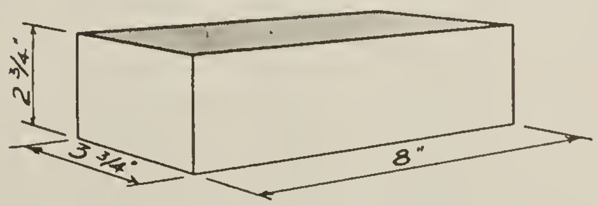


ROMAN

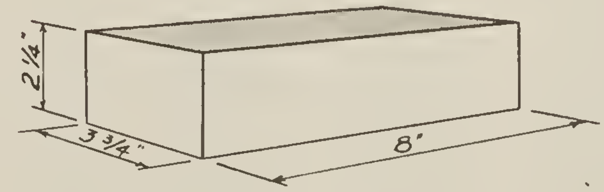
Modular Brick

Standard Brick and Engineer Brick are produced by some manufacturers for ⅜″ joints which increases the brick dimensions shown by ⅛″. Roman brick are also produced in 15½″ lengths. . . . All brick are cored at the manufacturers option.

NON-MODULAR BRICK



OVERSIZE



STANDARD

Non-Modular Brick

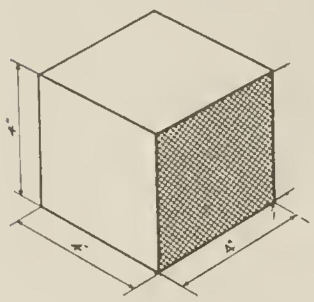
Modular dimensioning for vertical coursing may be obtained with the above units by adjusting the thickness of the horizontal mortar joint.

"Tomkins for the usual and unusual in Face Brick"

(S E E   O V E R)

EXPLANATION OF "MODULAR"

Both modular and non-modular sizes are shown. The modular units shown are dimensioned in accordance with approved standards of the American Standards Association. This simplification program, Project A62, within the building industry, is sponsored by the American Institute of Architects and Producers Council, Inc. The program's objective is to reduce construction costs through dimensional coordination of all building materials and equipment.



THE FOUR INCH CUBE

The three dimensions of Modular Brick are directly related to the four-inch cube. From this basic cube the 4″ Grid is developed. By this method of dimensioning all modular units will fit in some multiple of the 4″ Grid and are interchangeable in the thickness, length and height of a wall.

The nominal dimensions of a modular unit include the thickness of the mortar joint. As an example the nominal dimensions (unit plus joint) of a Modular Standard Brick are always 2-2/3″ x 4″ x 8″. The actual dimensions (unit only) are determined by deducting the thickness of the mortar joint from all three dimensions. If the mortar joint is ½″ the actual brick size will be 2-1/6″ x 3½″ x 7½″. If the mortar joint is ⅜″, the actual brick size will be 2-5/16″ x 3⅝″ x 7⅝″.

Modular dimensioning for vertical coursing may be obtained with non-modular brick by a slight adjustment in the thickness of the horizontal mortar joint.

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COURSING TABLES

Table I

BRICK HEIGHT TABLE FOR MODULAR BRICK

Height from Center Line to Center Line of Mortar Joints

BRICK FLAT—NOMINAL SIZES SHOWN
Nominal Dimensions include brick plus mortar joint.

No. of Courses	Roman 2"x4"x12"	Standard 2⅔"x4"x8"	Engineer 3.2"x4"x8"	Economy-8 4"x4"x8"	Economy-12 4"x4"x12"
1	0'- 2"	0'- 2⅔"	0'- 3.2"	0'-4"	0'-4"
2	0'- 4"	0'- 5⅓"	0'- 6.4"	0'-8"	0'-8"
3	0'- 6"	0'- 8"	0'- 9.6"	1'-0"	1'-0"
4	0'- 8"	0'-10⅔"	1'- 0.8"	1'-4"	1'-4"
5	0'-10"	1'- 1⅓"	1'- 4"	1'-8"	1'-8"
6	1'- 0"	1'- 4"	1'- 7.2"	2'-0"	2'-0"
7	1'- 2"	1'- 6⅔"	1'-10.4"	2'-4"	2'-4"
8	1'- 4"	1'- 9⅓"	2'- 1.6"	2'-8"	2'-8"
9	1'- 6"	2'- 0"	2'- 4.8"	3'-0"	3'-0"
10	1'- 8"	2'- 2⅔"	2'- 8"	3'-4"	3'-4"
11	1'-10"	2'- 5⅓"	2'-11.2"	3'-8"	3'-8"
12	2'- 0"	2'- 8"	3'- 2.4"	4'-0"	4'-0"
13	2'- 2"	2'-10⅔"	3'- 5.6"	4'-4"	4'-4"
14	2'- 4"	3'- 1⅓"	3'- 8.8"	4'-8"	4'-8"
15	2'- 6"	3'- 4"	4'- 0"	5'-0"	5'-0"
16	2'- 8"	3'- 6⅔"	4'- 3.2"	5'-4"	5'-4"
17	2'-10"	3'- 9⅓"	4'- 6.4"	5'-8"	5'-8"
18	3'- 0"	4'- 0"	4'- 9.6"	6'-0"	6'-0"
19	3'- 2"	4'- 2⅔"	5'- 0.8"	6'-4"	6'-4"
20	3'- 4"	4'- 5⅓"	5'- 4"	6'-8"	6'-8"
21	3'- 6"	4'- 8"	5'- 7.2"	7'-0"	7'-0"
22	3'- 8"	4'-10⅔"	5'-10.4"	7'-4"	7'-4"
23	3'-10"	5'- 1⅓"	6'- 1.6"	7'-8"	7'-8"
24	4'- 0"	5'- 4"	6'- 4.8"	8'-0"	8'-0"
25	4'- 2"	5'- 6⅔"	6'- 8"	8'-4"	8'-4"
26	4'- 4"	5'- 9⅓"	6'-11.2"	8'-8"	8'-8"
27	4'- 6"	6'- 0"	7'- 2.4"	9'-0"	9'-0"
28	4'- 8"	6'- 2⅔"	7'- 5.6"	9'-4"	9'-4"
29	4'-10"	6'- 5⅓"	7'- 8.8"	9'-8"	9'-8"
30	5'- 0"	6'- 8"	8'- 0"	10'-0"	10'-0"
31	5'- 2"	6'-10⅔"	8'- 3.2"	10'-4"	10'-4"
32	5'- 4"	7'- 1⅓"	8'- 6.4"	10'-8"	10'-8"
33	5'- 6"	7'- 4"	8'- 9.6"	11'-0"	11'-0"
34	5'- 8"	7'- 6⅔"	9'- 0.8"	11'-4"	11'-4"
35	5'-10"	7'- 9⅓"	9'- 4"	11'-8"	11'-8"
36	6'- 0"	8'- 0"	9'- 7.2"	12'-0"	12'-0"
37	6'- 2"	8'- 2⅔"	9'-10.4"	12'-4"	12'-4"
38	6'- 4"	8'- 5⅓"	10'- 1.6"	12'-8"	12'-8"
39	6'- 6"	8'- 8"	10'- 4.8"	13'-0"	13'-0"
40	6'- 8"	8'-10⅔"	10'- 8"	13'-4"	13'-4"
41	6'-10"	9'- 1⅓"	10'-11.2"	13'-8"	13'-8"
42	7'- 0"	9'- 4"	11'- 2.4"	14'-0"	14'-0"
43	7'- 2"	9'- 6⅔"	11'- 5.6"	14'-4"	14'-4"
44	7'- 4"	9'- 9⅓"	11'- 8.8"	14'-8"	14'-8"
45	7'- 6"	10'- 0"	12'- 0"	15'-0"	15'-0"
46	7'- 8"	10'- 2⅔"	12'- 3.2"	15'-4"	15'-4"
47	7'-10"	10'- 5⅓"	12'- 6.4"	15'x8"	15'-8"
48	8'- 0"	10'- 8"	12'- 9.6"	16'-0"	16'-0"
49	8'- 2"	10'-10⅔"	13'- 0.8"	16'-4"	16'-4"
50	8'- 4"	11'- 1⅓"	13'- 4"	16'-8"	16'-8"
60	10'- 0"	13'- 4"	16'- 0"	20'-0"	20'-0"
70	11'- 8"	15'- 6⅔"	18'- 8"	23'-4"	23'-4"
80	13'- 4"	17'- 9⅓"	21'- 4"	26'-8"	26'-8"
90	15'- 0"	20'- 0"	24'- 0"	30'-0"	30'-0"
100	16'- 8"	22'- 2⅔"	26'- 8"	33'-4"	33'-4"

Table II

BRICK HEIGHT TABLE For Brick Sizes Shown Below

Height from Bottom of Mortar Joint to Bottom of Mortar Joint

No. of Courses	BRICK FLAT 2¼" x 3¾" x 8"		2¾" x 3¾" x 8"	
	⅜" JOINT	½" JOINT	⅜" JOINT	½" JOINT
1	0'- 2⅝"	0'- 2¾"	0'- 3⅛"	0'- 3¼"
2	0'- 5¼"	0'- 5½"	0'- 6¼"	0'- 6½"
3	0'- 7⅞"	0'- 8¼"	0'- 9⅜"	0'- 9¾"
4	0'-10½"	0'-11"	1'- 0½"	1'- 1"
5	1'- 1⅛"	1'- 1¾"	1'- 3⅝"	1'- 4¼"
6	1'- 3¾"	1'- 4½"	1'- 6¾"	1'- 7½"
7	1'- 6⅜"	1'- 7¼"	1'- 9⅞"	1'-10¾"
8	1'- 9"	1'-10"	2'- 1"	2'- 2"
9	1'-11⅝"	2'- 0¾"	2'- 4⅛"	2'- 5¼"
10	2'- 2¼"	2'- 3½"	2'- 7¼"	2'- 8½"
11	2'- 4⅞"	2'- 6¼"	2'-10⅜"	2'-11¾"
12	2'- 7½"	2'- 9"	3'- 1½"	3'- 3"
13	2'-10⅛"	2'-11¾"	3'- 4⅝"	3'- 6¼"
14	3'- 0¾"	3'- 2½"	3'- 7¾"	3'- 9½"
15	3'- 3⅜"	3'- 5¼"	3'-10⅞"	4'- 0¾"
16	3'- 6"	3'- 8"	4'- 2"	4'- 4"
17	3'- 8⅝"	3'-10¾"	4'- 5⅛"	4'- 7¼"
18	3'-11¼"	4'- 1½"	4'- 8¼"	4'-10½"
19	4'- 1⅞"	4'- 4¼"	4'-11⅜"	5'- 1¾"
20	4'- 4½"	4'- 7"	5'- 2½"	5'- 5"
21	4'- 7⅛"	4'- 9¾"	5'- 5⅝"	5'- 8¼"
22	4'- 9¾"	5'- 0½"	5'- 8¾"	5'-11½"
23	5'- 0⅜"	5'- 3¼"	5'-11⅞"	6'- 2¾"
24	5'- 3"	5'- 6"	6'- 3"	6'- 6"
25	5'- 5⅝"	5'- 8¾"	6'- 6⅛"	6'- 9¼"
26	5'- 8¼"	5'-11½"	6'- 9¼"	7'- 0½"
27	5'-10⅞"	6'- 2¼"	7'- 0⅜"	7'- 3¾"
28	6'- 1½"	6'- 5"	7'- 3½"	7'- 7"
29	6'- 4⅛"	6'- 7¾"	7'- 6⅝"	7'-10¼"
30	6'- 6¾"	6'-10½"	7'- 9¾"	8'- 1½"
31	6'- 9⅜"	7'- 1¼"	8'- 0⅞"	8'- 4¾"
32	7'- 0"	7'- 4"	8'- 4"	8'- 8"
33	7'- 2⅝"	7'- 6¾"	8'- 7⅛"	8'-11¼"
34	7'- 5¼"	7'- 9½"	8'-10¼"	9'- 2½"
35	7'- 7⅞"	8'- 0¼"	9'- 1⅜"	9'- 5¾"
36	7'-10½"	8'- 3"	9'- 4½"	9'- 9"
37	8'- 1⅛"	8'- 5¾"	9'- 7⅝"	10'- 0¼"
38	8'- 3¾"	8'- 8½"	9'-10¾"	10'- 3½"
39	8'- 6⅜"	8'-11¼"	10'- 1⅞"	10'- 6¾"
40	8'- 9"	9'- 2"	10'- 5"	10'-10"
41	8'-11⅝"	9'- 4¾"	10'- 8⅛"	11'- 1¼"
42	9'- 2¼"	9'- 7½"	10'-11¼"	11'- 4½"
43	9'- 4⅞"	9'-10¼"	11'- 2⅜"	11'- 7¾"
44	9'- 7½"	10'- 1"	11'- 5½"	11'-11"
45	9'-10⅛"	10'- 3¾"	11'- 8⅝"	12'- 2¼"
46	10'- 0¾"	10'- 6½"	11'-11¾"	12'- 5½"
47	10'- 3⅜"	10'- 9¼"	12'- 2⅞"	12'- 8¾"
48	10'- 6"	11'- 0"	12'- 6"	13'- 0"
49	10'- 8⅝"	11'- 2¾"	12'- 9⅛"	13'- 3¼"
50	10'-11¼"	11'- 5½"	13'- 0¼"	13'- 6½"
60	13'- 1½"	13'- 9"	15'- 7½"	16'- 3"
70	15'- 3¾"	16'- 0½"	18'- 2¾"	18'-11½"
80	17'- 6"	18'- 4"	20'-10"	21'- 8"
90	19'- 8¼"	20'- 7½"	23'- 5¼"	24'- 4½"
100	21'-10½"	22'-11"	26'- 0½"	27'- 1"

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Estimate RIGHT

Don't be Left!

ESTIMATING TABLES

Table I

MODULAR BRICK AND MORTAR QUANTITIES

SOLID BRICK WALLS—RUNNING BOND

BRICK	JOINT	4" Wall: No. of Brick per SF	4" Wall: Mortar—CF Per SF of Wall	4" Wall: Mortar—CF Per 1000 Brick	8" Wall: No. of Brick per SF	8" Wall: Mortar Cu. Ft. per SF of Wall	12" Wall: No. of Brick per SF	12" Wall: Mortar Cu. Ft. per SF of Wall
Standard	3/8"	6.75	0.060	8.91	13.50	0.120	20.25	0.180
	1/2"	6.75	0.076	11.33	13.50	0.153	20.25	0.229
Engineer	3/8"	5.63	0.053	9.37	10.25	0.105	15.88	0.158
	1/2"	5.63	0.067	11.92	10.25	0.134	15.88	0.201
Economy-8 . . .	1/2"	4.50	0.058	12.81	9.00	0.115	13.50	0.173
Economy-12 . .	1/2"	3.00	0.052	17.27	6.00	0.104	9.00	0.155
Roman-12 . . .	1/2"	6.00	0.090	15.04	...	....	...	....
Roman-16 . . .	1/2"	4.50	0.088	19.49	...	....	...	....

Note: *For 1/2" collar joints add .0458 cu. ft. of mortar per square foot of collar joint.*

10% has been added to mortar quantities for waste.

Table II

NON-MODULAR BRICK AND MORTAR QUANTITIES

SOLID BRICK WALLS—RUNNING BOND

BRICK	JOINT	4" Wall: No. of Brick per SF	4" Wall: Mortar—CF Per SF of Wall	4" Wall: Mortar—CF Per 1000 Brick	8" Wall: No. of Brick per SF	8" Wall: Mortar Cu. Ft. per SF of Wall	12" Wall: No. of Brick per SF	12" Wall: Mortar Cu. Ft. per SF of Wall
2¼x3¾x8" . .	3/8"	6.55	.062	9.51	13.10	0.125	19.65	0.187
	1/2"	6.16	.079	12.83	12.32	0.158	18.48	0.237
2¾x3¾x8" . .	3/8"	5.50	.055	9.96	11.00	0.110	16.50	0.164
	1/2"	5.21	.070	13.43	10.42	0.140	15.64	0.210

Note: *For 1/2" collar joints add .0458 cu. ft. of mortar per square foot of collar joint.*

10% has been added to mortar quantities for waste.

Table III

CORRECTION FACTORS

For Face Brick in Various Bonds. Apply to 4" Wall Quantities in Table I.

TYPE OF BOND	CORRECTION FACTOR*
Common Bond, Full Headers every 5th Course	1/5
Common Bond, Full Headers every 6th Course	1/6
Common Bond, Full Headers every 7th Course	1/7
Flemish Bond, Alternate Stretcher & Header every Course	1/3
English Bond, Full Headers every other Course	1/2

**Add to face brick and deduct from backup.*

Table IV

QUANTITIES OF MORTAR MATERIALS

QUANTITIES PER CUBIC FOOT OF MORTAR

Type of Mortar	Weight: Cement Lb.	Weight: Hyd. Lime Lb.	Weight: Sand Lb.	Volume: Cement Sack	Volume: Hyd. Lime Sack	Volume: Sand Cu. Ft.
Type "A"—1:¼:3 For reinforced masonry and foundations . . .	28.2	3.0	73.6	0.3	0.06	0.92
Type "B"—1:1:6 For load bearing and exposed masonry . .	15.28	6.5	78.4	0.163	0.13	0.98
Type "C"—1:2:9 For interior non-load bearing masonry. . .	10.34	8.75	79.2	0.11	0.175	0.99

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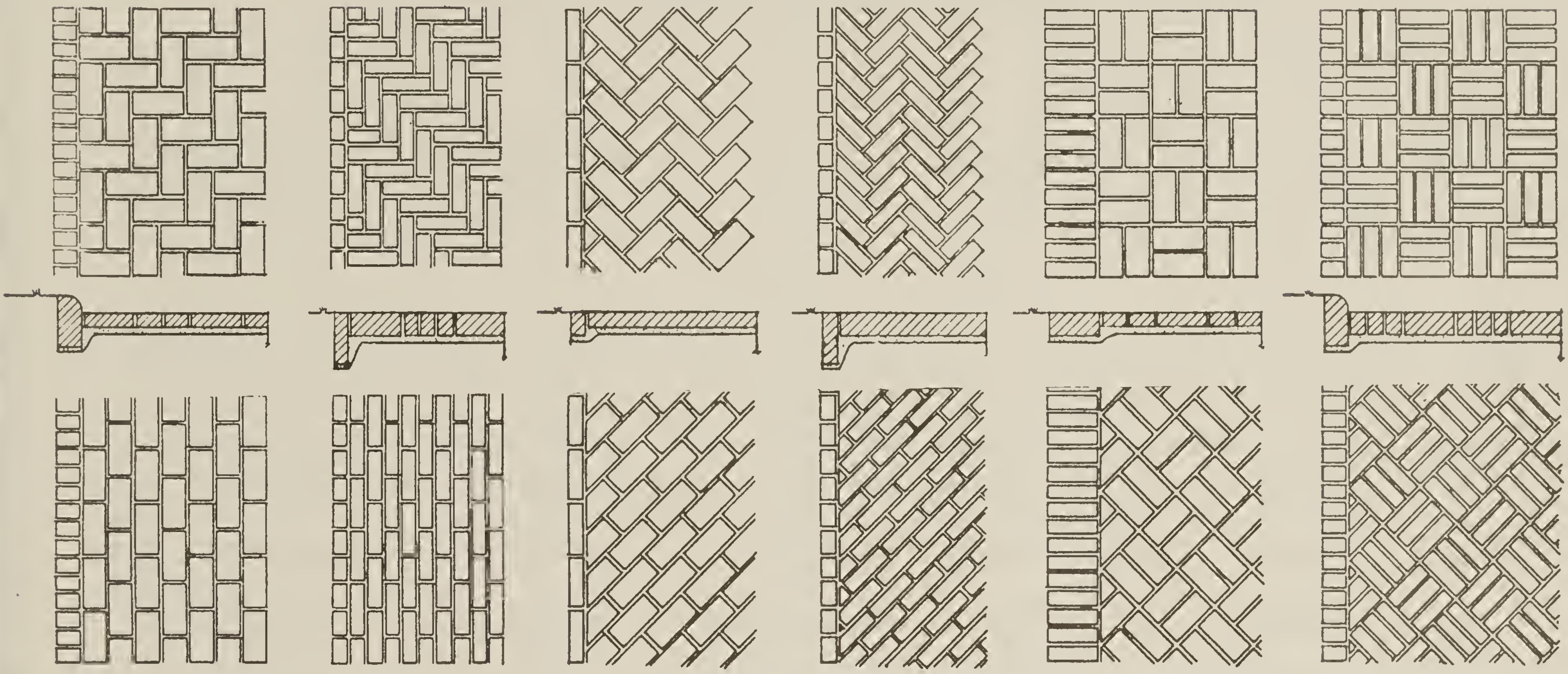
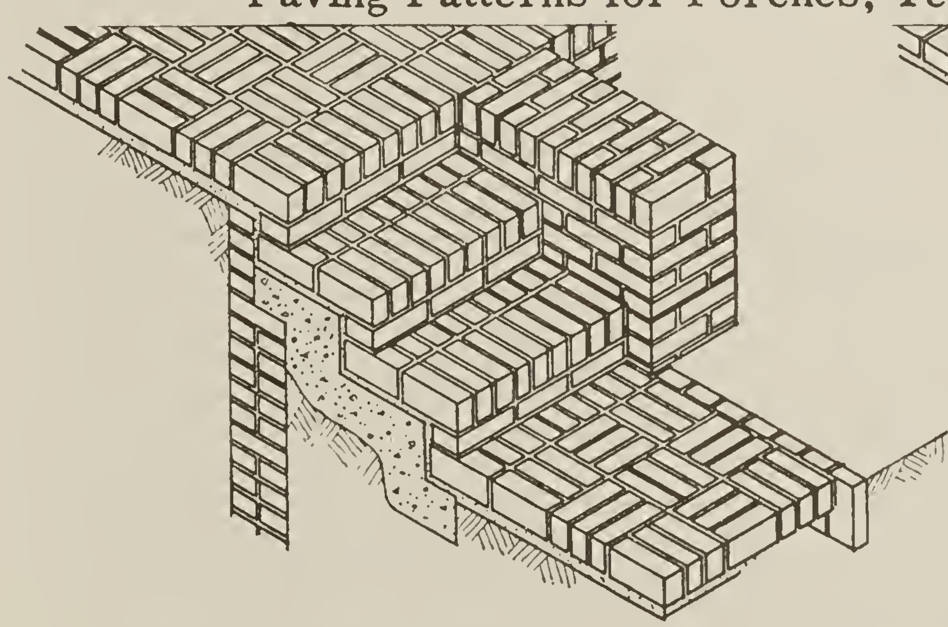
FOR CHARM AND UTILITY

BRICK PAVING AND STEPS

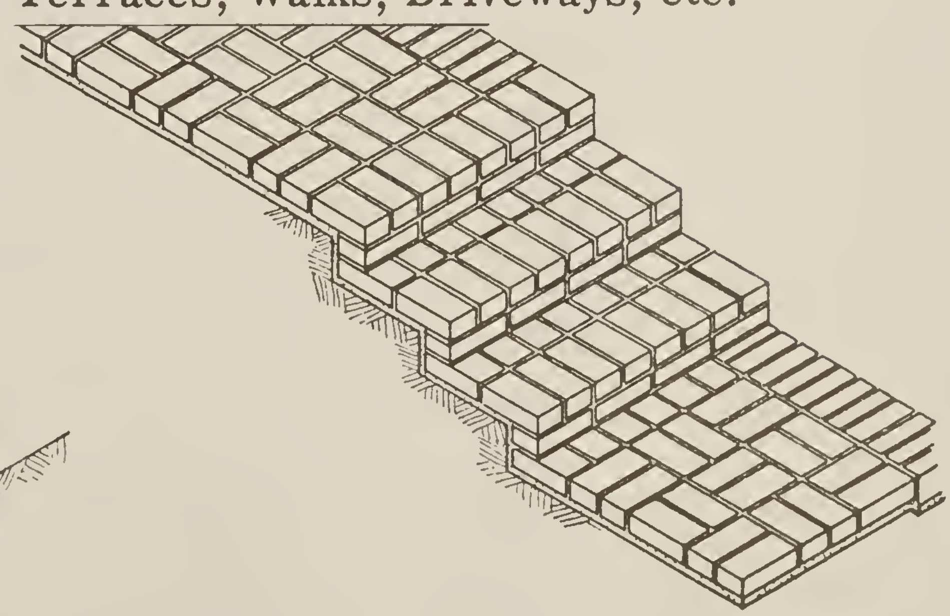


BRICK LAID FLAT BULLNOSE BORDER — BRICK ON EDGE HEADER BORDER — BRICK LAID FLAT STRETCHER BORDER — BRICK ON EDGE HEADER BORDER — BRICK LAID FLAT SOLDIER BORDER — BRICK ON EDGE BULLNOSE BORDER

Paving Patterns for Porches, Terraces, Walks, Driveways, etc.



STEPS CONNECTING WALK WITH PORCH OR TERRACE



STEPS CONNECTING WALK WITH WALK

Brick should be hard-burned and low in absorption. Under-burned or salmon brick should not be used for walks and terraces. The brick may be laid on a sand or concrete base. Walks laid on a sand base may become uneven, which in some cases may be the effect desired. However, in order to preserve a smooth surface, it is recommended that a sub-base, preferably 3″ deep, be made of a lean concrete (1:8) mix. Upon this a ½″ cushion of concrete and sand (1:4) mix should be spread and the brick laid directly on this cushion.

The joints may be filled by one of three methods: (a) dry sand swept into the joints, (b) a mix of sand and concrete (1:4 mix) dry, swept into the joints, or (c) a grout poured into the joints. When grout is used, the exposed surface only of the brick should be painted with a good coat of paraffin oil or raw linseed oil to prevent staining.

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FACE BRICK COMPARISON CHART

STANDARD	OVERSIZE	NORMAN	ROMAN
2-1/4 x 3-3/4 x 8	2-3/4 x 3-3/4 x 8	2-1/4 x 3-3/4 x 11-5/8	1-5/8 x 3-3/4 x 11-5/8

UNIT	ACTUAL SIZE	"A"	"B"	"C"	"D"	"E"
STANDARD	2-1/4 x 3-3/4 x 8	1000	6.55	--.--	.0566	8.647
OVERSIZE	2-3/4 x 3-3/4 x 8	840	5.50	16.0%	.0498	9.054
NORMAN	2-1/4 x 3-3/4 x 11-5/8	698	4.57	30.2%	.0530	11.597
ROMAN	1-5/8 x 3-3/4 x 11-5/8	916	6.00	8.4%	.0665	11.088

CODE OF TABLE

("A") Displacement of 1000 Standard

("B") Number Units Per Sq. Ft.

("C") Percentage Saving of Brick

("D") Cu. Ft. Mortar Per Sq. Ft. of Wall

("E") Cu. Ft. Mortar Per 1000 Units

Note: All figures based on 3/8" joint

FOR ADDITIONAL INFORMATION ON TEXTURE OR SHADES

CONTACT OUR NEAREST OFFICE.

T O M K I N S   B R O T H E R S

COST COMPARISON FORMULA

COLUMN 1		COLUMN 2	
NORMAN BRICK		STANDARD SIZE BRICK	
Cost del'd to job 1000 brick	$ 85.00	Cost del'd to job 1000 brick	$ 55.00
Cost of mortar 1000 brick	11.00	Cost of mortar 1000 brick	8.00
Cost of laying 1000 Norman brick	120.00	Cost of laying 1000 Std.brick	100.00
Total cost in wall	$216.00	Total cost in wall	$163.00

Since there is a 30% face area increase with Norman brick, multiply total cost of Norman brick laid in wall by 70%. That gives comparison of cost on brick equivalent basis.

Cost of Standard brick in wall- - - - - - - - - - - - - - - - $163.00

Cost of Normans on brick equivalent basis ($216.00 x 70%) - 151.20

Dollar savings by using Norman brick- - - - - - - - - - - - - $ 11.80

$11.80 when applied to brick means cost of Standard size brick to be $55.00 less $11.80 = $43.20

T O M K I N S   B R O T H E R S

COST COMPARISON FORMULA

COLUMN 1		COLUMN 2 OVERSIZE BRICK) Cross Out One STANDARD SIZE BRICK)	
Cost del'd to job 1000 brick	______	Cost del'd to job 1000 brick	_______(K)
Cost of mortar 1000 brick	______	Cost of mortar 1000 brick	_______
Cost of laying 1000 brick	______	Cost of laying 1000 brick	_______
Total cost in wall	______ (Q)	Total cost in wall	_______(Y)

A. Since a standard (Oversize) brick is ____% smaller than a _____________ brick (Column 1), multiply total cost of that unit laid in wall by the percentage difference from 100.

(Q) __________ x ____________ = _______(A)

B. Then subtract that figure (A) from (Y). That gives you actual saving with _____________unit per equivalent area. _______

C. This saving deducted from (K) is actual cost of _________ face brick when compared to equal area of Standard Size (Oversize) brick. _______

% decrease of Standard size brick when compared to the following:

Oversize	16%
Norman	30%
Norwegian Brick	41%
Economy 8"	27%
Economy 12"	52%
Magnolian 18"	54%

% decrease of Oversize Common when compared to the following:

Norwegian Brick	34%
Economy 8"	18%
Economy 12"	46%

NOTE: To transpose this into cost per square foot, multiply total cost of brick in wall (Q) by number of brick per square foot.

(Y) ___________ x ___________ = $_________

(Q) ___________ x ___________ = $_________

(SEE OTHER SIDE)

NUMBER OF BRICK PER SQUARE FOOT

Standard Size	6.55
Oversize	5.21
Roman	5.59
Norman	4.57
Norwegian	3.65
Economy 8"	4.50
Economy 12"	3.00
Magnolian 18"	2.87

T O M K I N S   B R O T H E R S

COST COMPARISON FORMULA

COLUMN 1			COLUMN 2 OVERSIZE BRICK) Cross Out One STANDARD SIZE BRICK)		
Cost del'd to job 1000 brick	______		Cost del'd to job 1000 brick	_______	(K)
Cost of mortar 1000 brick	______		Cost of mortar 1000 brick	_______	
Cost of laying 1000 brick	______		Cost of laying 1000 brick	_______	
Total cost in wall	______	(Q)	Total cost in wall	_______	(Y)

A. Since a standard (Oversize) brick is ____% smaller than a ______________ brick (Column 1), multiply total cost of that unit laid in wall by the percentage difference from 100.

(Q) ___________ x _____________ = _______(A)

B. Then subtract that figure (A) from (Y). That gives you actual saving with ______________unit per equivalent area. _______

C. This saving deducted from (K) is actual cost of __________ face brick when compared to equal area of Standard Size (Oversize) brick. _______

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T O M K I N S   B R O T H E R S

COST COMPARISON FORMULA

COLUMN 1		COLUMN 2 OVERSIZE BRICK) Cross Out One STANDARD SIZE BRICK)	
Cost del'd to job 1000 brick	______	Cost del'd to job 1000 brick	_______(K)
Cost of mortar 1000 brick	______	Cost of mortar 1000 brick	_______
Cost of laying 1000 brick	______	Cost of laying 1000 brick	_______
Total cost in wall	______ (Q)	Total cost in wall	_______(Y)

A. Since a standard (Oversize) brick is ____% smaller than a ______________ brick (Column 1), multiply total cost of that unit laid in wall by the percentage difference from 100.

(Q) __________ x ____________ = _______(A)

B. Then subtract that figure (A) from (Y). That gives you actual saving with ______________unit per equivalent area. _______

C. This saving deducted from (K) is actual cost of __________ face brick when compared to equal area of Standard Size (Oversize) brick. _______

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(Q) ____________ x ____________ = $__________

(SEE OTHER SIDE)

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Standard Size	6.55
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TYPE OF WORKMANSHIP RECOMMENDED TO SECURE

Dry Brick Walls

A I A File No. 5-A

FOREWORD

Leaky brick walls are probably the most misunderstood problem in the building industry, and the one about which the most misinformation has been published.

Most authorities agree that dry brick walls depend much more on proper design and good workmanship than on the brick or mortar used.

This paper makes no attempt to discuss design. Flashing and spandrel waterproofing—lintels designed to shed the water out of rather than into the wall—provision against expansion, contraction and deflection of floor and roof slabs, beams and trusses . . . these and all other construction details are the responsibility of the architect.

The purpose of this paper is to describe and illustrate the type of workmanship which, together with proper design, will insure watertight walls.

John H. Mallon, Vice-President
Louisville Cement Co., Louisville, Ky.

8th Printing

BED JOINTS

MORTAR for the bed joint should be spread thick. The furrow in the mortar should be made shallow, not deep.

Then there will be enough excess mortar in the bed joint to completely fill the furrow when the brick are bedded to the line. This will give full bed joints.

A thick bed of mortar should be spread on the wall.

The furrow in the mortar should be shallow, not deep.

Then the excess mortar will fill the furrow and insure full bed joints.

IF the mortar for the bed joint is spread too thin, or if the furrow in the mortar is made too deep, there will be insufficient mortar in the bed joint to completely fill the furrow, when the next course of brick is bedded. This will leave a channel along which water, entering from some open joint, may travel until it finds a passage to the inside of the wall.

The mortar in this bed joint is spread too thin.

The furrow in this bed joint is too deep.

In either case there is not enough mortar in the bed joint to completely fill the furrow.

BED JOINTS (CONTINUED)

WHEN absorbent brick are used, especially in hot weather, mortar for the bed joint should be spread out over only a few brick at a time. The brick should be placed on top of this mortar immediately, before it has a chance to stiffen.

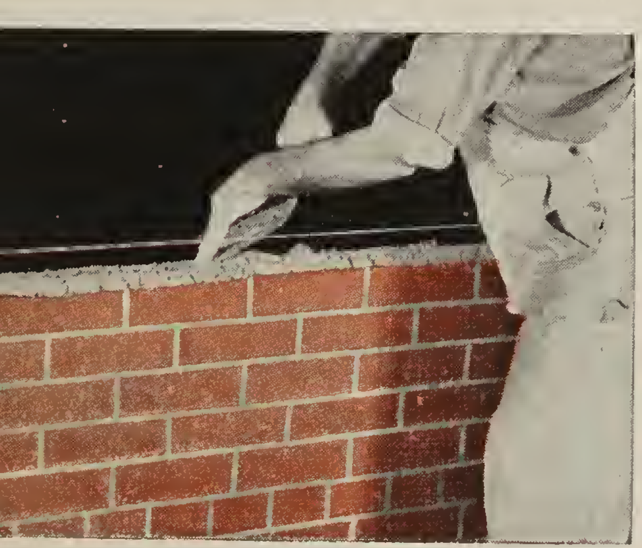
If the mortar is still soft and plastic when the brick are bedded, the mortar will stick to the brick placed on top of it as well as to the brick on which it is spread. This will give a good bond above as well as below the bed joint.

The mortar should be spread over a few brick only.

So the mortar will still be soft and plastic when the brick are bedded.

Then the mortar will stick to the brick placed on top of it as well as to the brick on which it is spread.

IF the mortar is spread out too far on the wall, or if any delay occurs between spreading the mortar and placing the brick on top of it, the mortar will be sucked dry before the next course of brick is bedded. In this case the mortar will not stick to the brick placed on top of it, and there will be no bond between the brick and the mortar.



Mortar for this bed joint was spread out on the wall too far.

So the mortar dried out too much before the next course of brick was placed on top of it.

Therefore the mortar did not stick to the top brick. A good bond was not secured.

HEAD JOINTS IN STRETCHER COURSES

ALL head joints in both face brick and back-up work should be completely filled with mortar by using any of the following methods:

(Method 1) *Throw plenty of mortar on the end of the brick to be placed. (This should be done in such a way that the mortar is scraped off the trowel by the bottom edge of the end of the brick.) Then push the brick into place so that the mortar oozes out at the top of the head joint.*

Plenty of mortar should be thrown on the end of the brick to be placed.

The brick should then be pushed into place.

So that the mortar oozes out at the top of the head joint.

(Method 2) *Spot a dab of mortar on the corner of the brick already in place. Then also throw plenty of mortar on the end of the same brick, so there will be more than enough mortar to fill the joint completely, when the next brick is pushed into place.*

A dab of mortar should be spotted on the corner of the brick already in place.

Then plenty of mortar should be thrown on the end of the brick already in place.

So there will be more than enough mortar to fill the joint completely when the next brick is pushed into place.

(Method 3) *Throw a deep bed of mortar on the wall; then shove the brick into place, so that the mortar oozes out at the top of the joint.*

A full trowel of mortar should be thrown on the wall.

Then the brick should be shoved into this deep bed of mortar.

So that the mortar oozes out at the top of the joint.

HEAD JOINTS IN STRETCHER COURSES (CONTINUED)

If the head joints are not completely filled with mortar, in both face brick and back-up work, water may penetrate to the inside of the wall through openings in the joints.

A dab of mortar spotted on one corner of the brick is not nearly enough to fill the head joint.

When a dab of mortar is spotted on one corner of the brick,

the mortar does not fill the head joint.

Only part of the head joint is filled with mortar.

A dab of mortar spotted on both corners of the brick is still not enough to fill the head joint completely.

Even when a dab of mortar is spotted on both corners of the brick,

the mortar does not completely fill the head joint.

Voids are still left in the head joints.

Slushing cannot be relied upon to completely fill voids left in the head joints.

Slushing does not properly fill the voids in the head joints.

When mortar is spotted on only one corner of the brick, slushing seldom fills the voids.

Even when mortar is spotted on both corners of the brick, slushing will not always fill the voids.

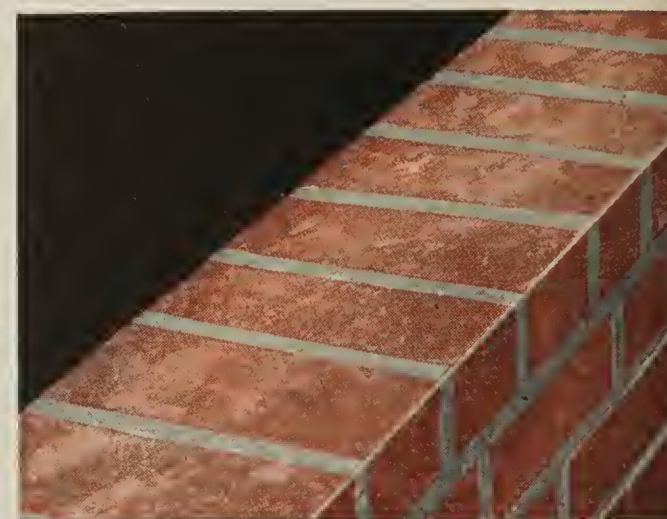
CROSS JOINTS IN HEADER COURSES

IN header courses, all vertical joints should be completely filled with mortar by using the following method:

Spread mortar over the entire side of the header brick before it is placed in the wall. Then push the brick into place, so that the mortar oozes out at the top of the joint.

Mortar should be spread over the entire side of the header brick before it is placed in the wall.

The brick should be shoved into place so that mortar oozes out at the top of the joint.



This completely fills the joint.

IN header courses, full cross joints are seldom secured on the average job.

A dab of mortar spotted on one corner of the brick cannot possibly fill the cross joint. Slushing will not fill the voids.

When a dab of mortar is spotted on one corner of the brick,

there is very little mortar in the cross joint.

Slushing will not fill the voids.

A dab of mortar spotted on both corners of the brick is not nearly enough to fill the joint. Slushing will seldom fill the voids completely.

Even when mortar is spotted on both corners of the header brick,

there is not enough mortar in the joint.

Slushing will seldom fill the voids.

CLOSURES

CLOSURES IN STRETCHER COURSES

BEFORE placing the closure brick, mortar should be spotted on the ends of both brick already in place. In addition, mortar should be thrown onto both ends of the closure brick. The closure brick should then be laid without disturbing the brick already in place.

Mortar should be spotted on the ends of both brick already in place.

And in addition, mortar should be thrown on both ends of the closure brick.

Then the closure brick should be laid without disturbing the brick already in place.

CLOSURES IN HEADER COURSES

BEFORE laying the closure brick, plenty of mortar should be placed on the sides of both brick already in place. In addition, mortar should be spread on both sides of the closure brick. The closure brick should then be laid without disturbing the brick already in place.

Plenty of mortar should be placed on the sides of both brick already in place.

And in addition, mortar should be spread on both sides of the closure brick.

Then the closure brick should be laid without disturbing the brick already in place.

TILE OR BLOCK

IN laying clay tile, or concrete or cinder block, even when they are used for back-up work only, especial care should be exercised to secure full head joints on both the inside and the outside edges of the unit. Either of the following methods may be used:

(Method 1) *Throw up full head joints on both edges of the unit to be placed; or*

(Method 2) *Throw up a full head joint on the interior edge of the unit already in place, and also a full head joint on the opposite edge of the unit to be placed.*

With either of the above methods, in order to make sure the joints on both sides of the unit are completely filled, enough mortar should be used to cause excess mortar to ooze out of the joints on both sides of the unit.

TILE

Method 1—Full head joints should be thrown onto both edges of the tile to be placed.

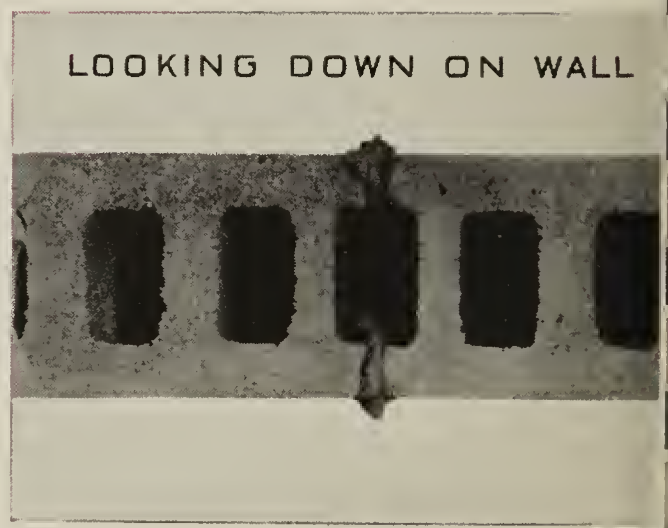
Method 2—A full head joint should be thrown onto one edge of the tile in place and also a full head joint onto the opposite edge of the tile to be placed.

Enough mortar should be used to cause excess mortar to ooze out of the joints on both sides of the tile.

BLOCK

Method 1—Full head joints should be thrown onto both edges of the block to be placed.

Method 2—A full head joint should be thrown onto one edge of the block already in place and also a full head joint onto the opposite edge of the block to be placed.



Enough mortar should be used to cause excess mortar to ooze out of the joints on both sides of the block.

TILE OR BLOCK (CONTINUED)

TILE or block back-up units offer very little protection against the penetration of water, unless both inside and outside head joints in the back-up work are completely filled with mortar.

TILE


It is not sufficient to provide head joints on the inside face of the wall only. Both methods shown above leave open head joints in the interior of the wall, next to the face brick.

Such back-up work offers practically no protection against the penetration of water.

BLOCK


It is not sufficient to provide head joints on the inside face of the wall only. Both methods shown above leave open head joints in the interior of the wall, next to the face brick

Such back-up work offers practically no protection against the penetration of water.

TYPE OF JOINT

ALL joints on the exterior face of the wall should be tooled to give a concave finish.

This should be done with a round tool slightly larger than the joint, before the mortar hardens, and with sufficient force to press the mortar tight against the brick on both sides of the mortar joint.

Such tooling helps seal any cracks between the mortar and the brick which may have been left when the brick were laid.

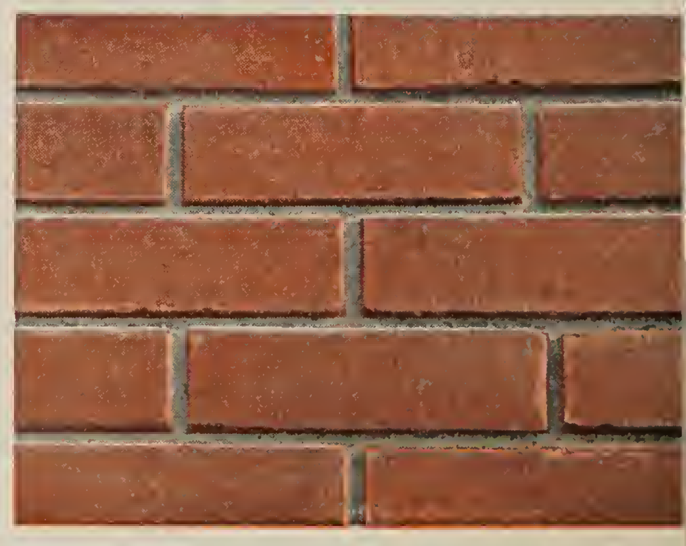
Before the mortar hardens, joints should be finished to give a concave surface. This should be done with a round tool slightly larger than the joint, and with sufficient force to press the mortar tight against the brick on both sides of the mortar joint.

This helps seal any cracks between the brick and the mortar which may have been left when the brick were laid.

CONCAVE joints should always be used for face brick, unless the architecture requires some other type of finish. No other type of joint provides as much protection against the entrance of water.

A weathered joint does not always pack the mortar against the top brick thoroughly.

A struck joint leaves a shelf on which water collects.



A raked joint leaves a bad shelf and often contains too little mortar especially in the head joint.

*W*HEN joints are cut flush with the brick, cracks are immediately apparent between the brick and the mortar at the surface of the wall. These cracks do not extend back through the entire width of the brick. They run back only a fraction of an inch. Such cracks are not due to shrinkage. The pictures below explain how they occur.

When the bricklayer taps the brick down to the line, the mortar in the bed joint oozes out, and hangs down over the wall, pulling away from the edge of the brick above.

Then if the mortar in the bed joint is cut off with a sideways stroke of the trowel, the mortar is not pushed up against the edge of the brick above, and a crack remains on top of the bed joint.

If the mortar in the bed joint is cut off with an upward stroke, the trowel frequently pulls the mortar away from the edge of the brick below, and a crack is opened below the bed joint.

The head joint should be cut off with an upward stroke of the trowel.

If a sideways stroke of the trowel is used to cut off the head joint, the trowel frequently pulls the mortar away from the edge of the brick and forms a crack on the side of the mortar joint from which the stroke was made.

NAIL HOLES

WHEN a nail or line-pin is used, the hole should be immediately plugged with mortar when the nail is removed.

Nail holes sometimes connect with voids in the head joints, which, in turn, connect with unfilled furrows in the bed joints. Water entering through the nail holes may travel through connecting voids, until it finds a passage to the inside of the building.

When a nail or line-pin is used, the hole should be plugged with mortar as soon as the nail is removed.

Nail holes frequently connect with voids in the head joints which in turn connect with unfilled furrows in the bed joint.

Water entering through the nail holes may travel through connecting voids and find an opening to the inside of the building.

SHIFTING POSITION OF BRICK

THE position of the brick should never be shifted after they have been laid. If brick have been improperly spaced, so there is too little or too much space for the closure brick, and it is necessary to correct the width of the head joints, the brick and the mortar should be removed from the wall. and the brick should be relaid with fresh mortar.

Shifting the brick breaks the bond and causes cracks between the brick and the mortar.

After the brick have once been laid,

thereafter, the position of the brick should never be changed. Shifting the brick breaks the bond between the brick and the mortar, and causes cracks in the wall.

BRICK must be laid true to the line, when originally placed. If any delay occurs before they are tapped into place, the bond will be broken, and a crack will result.

Any brick which are disturbed after laying should be removed and relaid with fresh mortar.

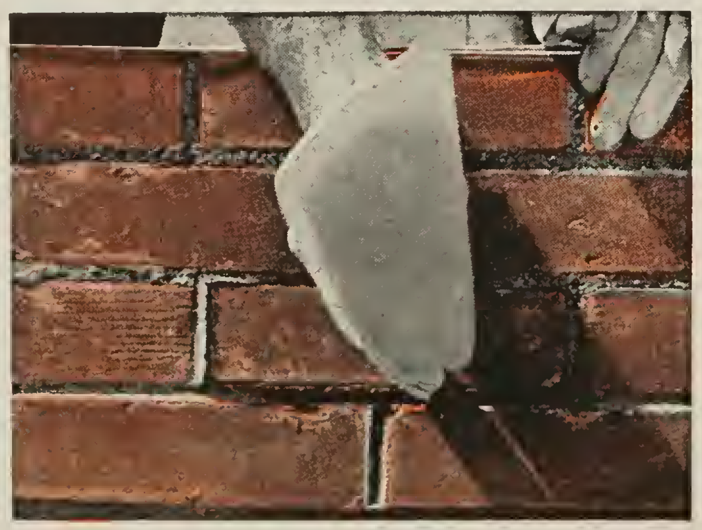
If a brick is not laid true to the line when originally placed,

and if the bricklayer comes back and taps it into place later,

cracks will result.

REALIGNMENT of a brick should not be attempted after a higher or following course of brick has been laid. Tapping back a protruding brick will break the bond and leave a crack.

Realignment of a brick should not be attempted after a higher or following course has been laid.



When a brick is hammered back into line, the bond between the brick and mortar is broken.

Cracks due to such realignment are frequently found at the corners of the wall.

PARGING

THE face brick should be backplastered with not less than 3/8 of an inch of mortar before the back-up units are laid.

Or, if the back-up units are laid first, the front of the back-up units should be plastered with not less than 3/8 of an inch of mortar before the face brick are laid.

Before the face brick are backplastered, however, the joints on the back of the face brick should be cut flush. The backplastering should not be done over mortar protruding from the joints.

The face brick should be backplastered.

If the back-up units are laid first, the front of the back-up units should be plastered.

Backplastering should not be attempted over protruding mortar joints.

SLUSHING DOES NOT TAKE THE PLACE OF BACK-PLASTERING

Frequently specifications are written providing either that the face brick should be back-plastered or that the space between the face brick and the back-up units should be slushed full of mortar.

Slushing does not give the same protection against the penetration of water that back-plastering gives.

It is almost impossible by slushing to completely fill the space between the face brick and the back-up work. Frequently the mortar is caught and held before it reaches the bottom of the narrow crevass, leaving openings between the face brick and the back-up units.

Even when this space is filled, there is no way to compact the mortar against the face brick. The mortar does not bond with the brick over its entire surface. Channels are left between the mortar and the brick, through which water can trickle down behind the face brick until it finds a header or a floor along which it can travel to reach the back of the wall.

Slushing does not completely fill the space between the face brick and the back-up work.

BRICK

Except in freezing weather, all brick (except highly impervious brick) should be wetted thoroughly a few hours before they are laid in the wall. A stream of water should be played on the pile of brick, until each individual brick has been thoroughly soaked.

Wetting of absorbent brick is necessary to reduce the rate of suction of the brick, so that they will not suck the water out of the mortar too fast. If the absorption is too rapid, so much water is removed from the mortar by the dry brick that the mortar congeals and does not bond properly with the next brick placed in contact with it.

MORTAR

Mortar on the boards should be kept well tempered with water so it will be soft and workable when placed in the wall.

The mortar should be plastic to enable the bricklayer to properly bed the brick and fill the joints.

The mortar should have high water-retaining capacity to keep the brick from sucking the water out of the mortar too fast when spread out on the wall. The mortar must stay soft and plastic long enough to permit a thorough bedding of the brick and to secure a good bond with the brick.

Mortar on the boards should be kept well tempered with water.

Mortar should be plastic to enable the bricklayer to properly bed the brick and fill the joints.

Mortar should have high water-retaining capacity to keep the brick from sucking the water out of the mortar too fast.

BRIXMENT FOR MORTAR

For thirty-five years, Brixment has been recognized as the leading masonry cement. It is designed to produce mortar combining plasticity, water retention, bonding quality, strength, durability and freedom from efflorescence.

Two of the outstanding characteristics of Brixment mortar are its excellent plasticity and its high water-retention.

Because it has these characteristics to such a high degree, Brixment mortar furnishes as great protection against leaky brick walls as can be secured with any kind or type of mortar materials.

LOUISVILLE CEMENT COMPANY
Incorporated
Louisville, Kentucky

THE ASSOCIATED GENERAL CONTRACTORS of America, Inc.

Munsey Building — Washington 4, D. C.

February 1, 1945.

Louisville Cement Company,
Speed Building,
Louisville,
Kentucky.

Gentlemen:

Thank you for the privilege of reviewing your proposed brochure on the proper bedding and jointing of brick masonry. It is my belief that this is a worthy and opportune contribution to the literature of the Industry.

I am sure that full observance of the recommendations made would go far in reducing the likelihood of the development of dampness and leaks in brick masonry. Such a result will be of substantial help in creating additional confidence in construction.

Sincerely yours,

H. E. Foreman

H. E. FOREMAN,
Managing Director.

Structural Clay Products Institute

1756 K STREET N. W.
WASHINGTON 6, D. C.
PHONE REPUBLIC 1475

March 1, 1945

Mr. John H. Mallon
Louisville Cement Company
Speed Building
Louisville, Kentucky

Dear Mr. Mallon:

I have reviewed your paper describing and illustrating recommended methods of laying brick and tile with a great deal of interest.

Your pictorial presentation of this subject is most convincing and the effectiveness of the workmanship which you recommend in producing watertight walls has been proved by years of experience in the field as well as by extensive laboratory investigations.

Permit me to congratulate you upon an excellent piece of work and to express the hope that the methods which you recommend will be adopted widely by brick masons and used extensively by architects and engineers in developing specifications for masonry.

Very truly yours,

Harry C. Plummer

Harry C. Plummer, Director
Engineering and Research

HCP.sh

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Bricklayers, Masons and Plasterers' International Union of America

HEADQUARTERS
BOWEN BUILDING
615-23 15TH STREET, N. W.

WASHINGTON 5, D. C.

January 17, 1945

Mr. John Mallon, Vice President
Louisville Cement Company, Inc.
Louisville, Kentucky

Dear Mr. Mallon:

In the formulation of specifications, I think it would not be an act of wisdom to bring into those specifications anything that might increase the cost of brick work extensively. We are in accord with all of your proposals regarding workmanship, and are of the opinion that while they may bring about a slight increase in construction cost, they would result in considerable saving in the maintenance of the building and the prevention of water leaks or dampness striking through the wall, which would more than offset this factor.

There will be absolutely no exterior maintenance cost such as painting, and the purchaser or home dweller will be relieved of having to repaper or repaint the interior of the exterior walls due to dampness or water leaks on account of faulty brick construction.

If you will furnish my office with a set of the specifications I will be glad to send them to our subordinate unions advising that they request the architects in their districts to use them as a standard specification for brick work.

Very truly yours,

R. J. Gray

Secretary

RJG:hh

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THE AMERICAN INSTITUTE OF ARCHITECTS
1741 NEW YORK AVENUE, N. W.
WASHINGTON 6, D. C.

April 12, 1945

Mr. John H. Mallon, Vice-President
Louisville Cement Company, Inc.
Speed Building
Louisville, Kentucky

Dear Mr. Mallon:

Second only to the importance of structural safety masonry construction should provide a high degree of resistence to penetration of moisture, if satisfactory performance is to be assured and subsequent makeshift measures involving material maintenance costs are to be avoided.

Experience and research have demonstrated the dependence of masonry construction upon the character and quality of workmanship necessary to provide protection against the penetration of moisture.

To insure weathertightness of masonry it is of importance that sound methods of construction should be understood by those who design and specify the work, the contractors who construct the same, and the craftsmen responsible for its field fabrication.

In providing information, in the form of step-by-step illustrations of masonry construction with appropriate descriptive text, as well as showing in contrast typical but less effective details of construction, you have made a worthwhile contribution to sound construction which should be helpful to those interested in the weathertight qualities of brick masonry.

Sincerely yours,

Raymond J. Ashton

Raymond J. Ashton
President

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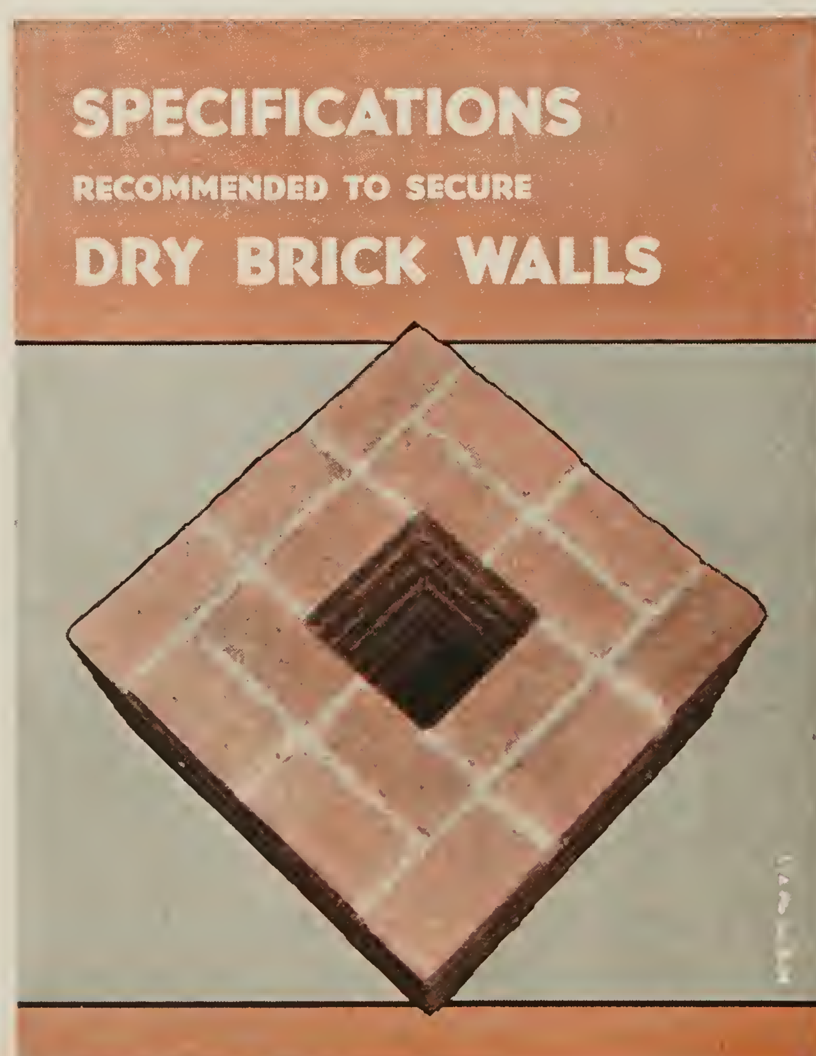
Over the past 20 years a great deal of careful research by outstanding authorities has been carried on to determine how water can be prevented from passing through brick walls.

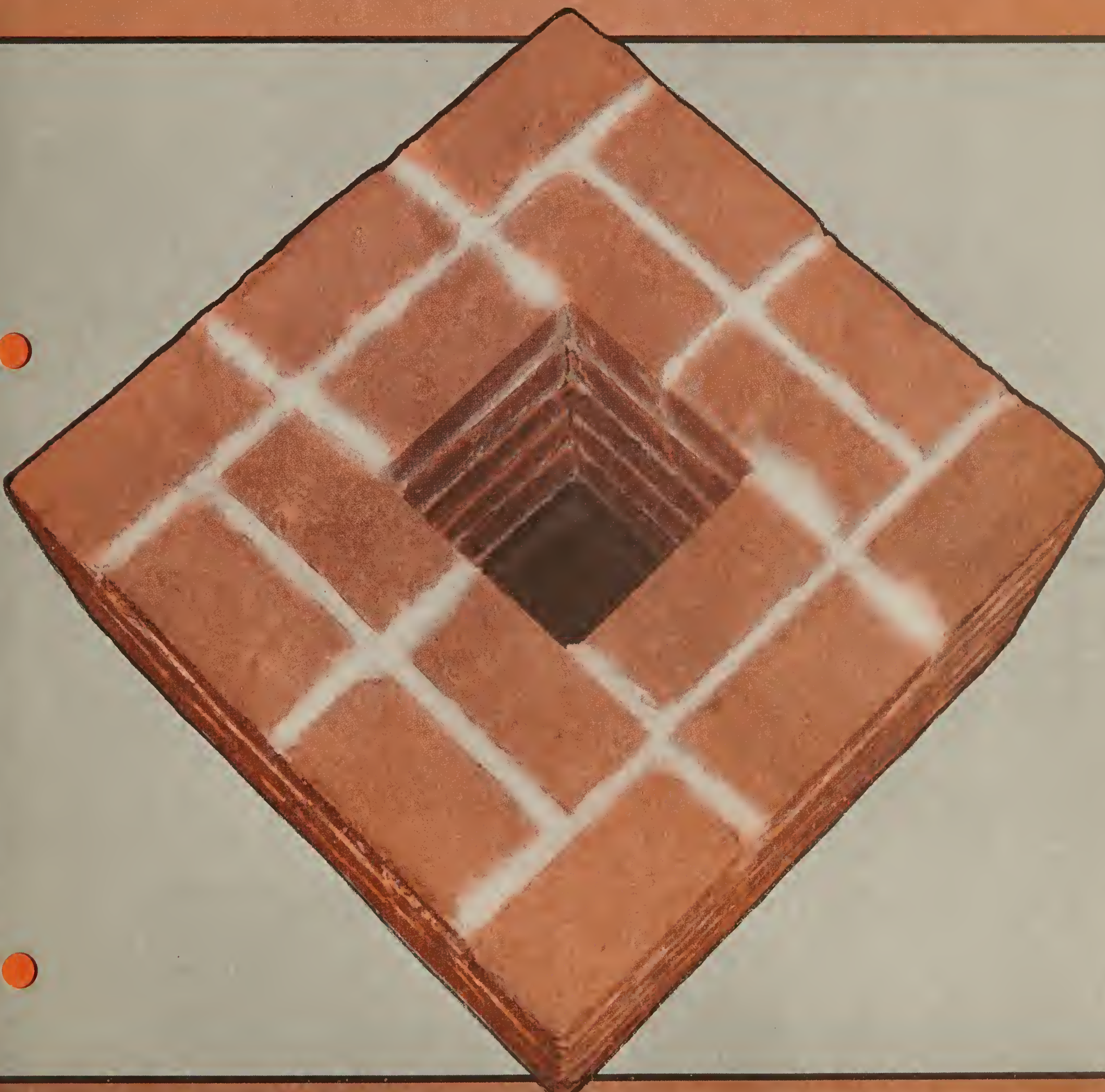
The pamphlet shown on the right sets forth and explains the significant facts secured in this research and, based on these facts, recommends certain precautions which should be included in the architect's specifications in order to secure dry brick walls. A copy will be sent free, without obligation, to any architect, contractor, bricklayer, or dealer who requests it. Write the Louisville Cement Co., Dept. 11, Louisville, Kentucky, for this "Specifications Book."



SPECIFICATIONS

RECOMMENDED TO SECURE

DRY BRICK WALLS



A.I.A. File No. 3-M

FOREWORD

OVER the past 20 years a great deal of careful research has been carried on to determine how water can be prevented from passing through brick walls. Significant facts have been determined and successful methods have been demonstrated. This information is available to anyone who will study the reports of this research work. However, these reports are so scattered and so technical that the facts they present, though really very simple, are still not generally known in the building industry.

The purpose of this paper is to set forth and explain the significant facts secured in this research and, based on these facts, to recommend certain precautions which should be included in the architect's specifications. All these precautions should be enforced, in order to secure dry brick walls.

This paper covers only the proper use of brick and mortar. No attempt is made to discuss such important details of design as flashing and spandrel waterproofing — lintels designed to shed the water out of rather than into the wall — protruding ledges of brick or stone — provision against expansion, contraction, and deflection of floors and roof slabs, beams and trusses — etc.

* * * * * *

The author gratefully acknowledges the encouragement and invaluable technical assistance given him during the preparation of this book, by F. O. Anderegg, Director, Building Materials Research Department, John B. Pierce Foundation; by C. C. Fishburn, Materials Engineer, National Bureau of Standards; by J. W. McBurney, Technologist, National Bureau of Standards; by D. E. Parsons, Chief, Building Technology Division, National Bureau of Standards; and by Harry C. Plummer, Director of Engineering and Technology, Structural Clay Products Institute. Without their help, this paper could hardly have been written.

John H. Mallon, *Vice President*
Louisville Cement Co., Louisville, Ky.

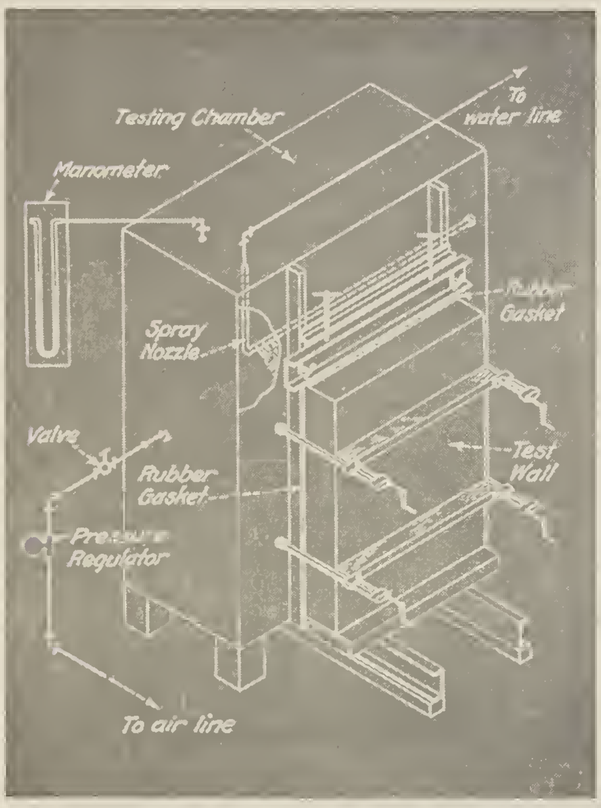
Printed in U.S.A.

Second Printing, July, 1952

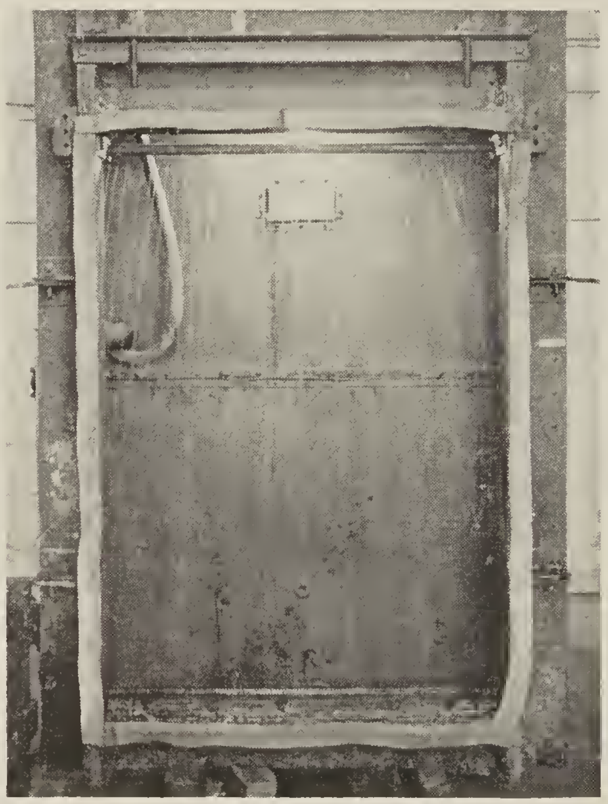
THE CAUSES AND PREVENTION OF LEAKY BRICK WALLS HAVE BEEN STUDIED FOR MANY YEARS BY OUTSTANDING RESEARCH AUTHORITIES

During the past twenty years, a great amount of intensive investigation has been done to determine how water can be prevented from passing through brick walls. This research has included a project by the National Bureau of Standards, in which more than 400 brick walls were erected and tested for more than five years—also a project in Pittsburgh, in which more than 300 brick panels were erected and studied for two years, by Dr. F. O. Anderegg and a committee of fifteen architects, contractors and masons.

The photographs immediately below show a water-permeability test chamber used in testing walls at the National Bureau of Standards. With this equipment, walls were tested under conditions resembling exposure to a strong wind and heavy rains. Water was applied by means of a spray at the top of the wall, causing a continuous film of water on the exposed face of the wall. The effect of a strong wind was simulated by maintaining an air-pressure of 10 pounds per square foot on the exposed face of the wall.

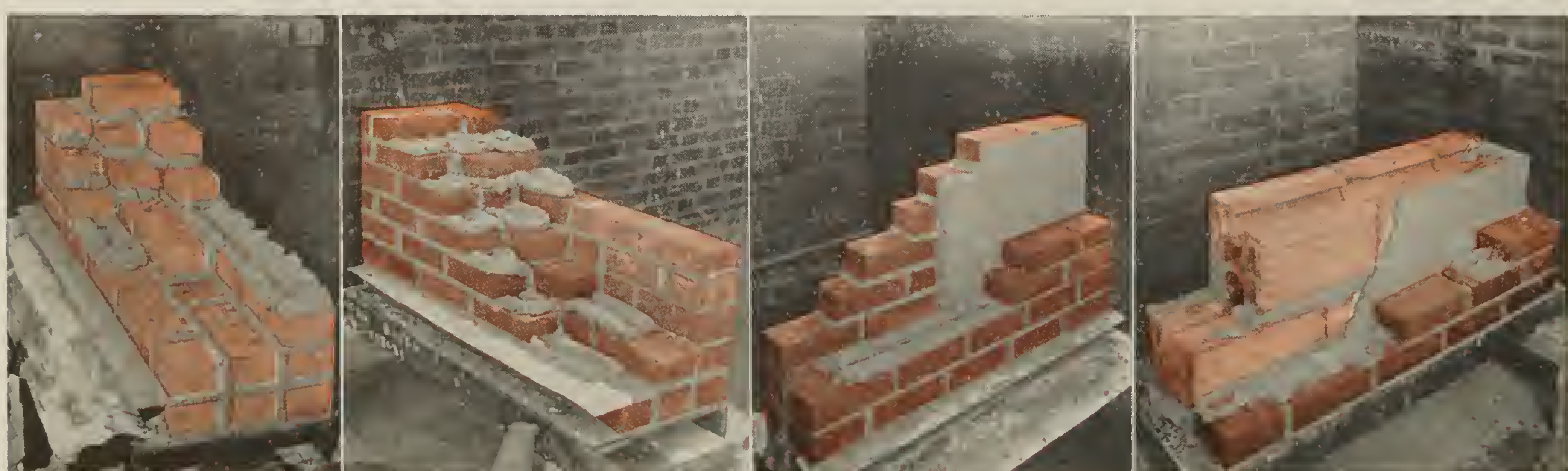


Isometric projection of testing equipment



Test chamber without wall

Test chamber with wall in place



A few examples of the many different types of walls tested at the National Bureau of Standards

Above and Below: Scenes showing some of the 300 brick panels erected and studied in Pittsburgh

Brick reservoirs were used for tests at Louisville Cement Co., also at Alton Brick Co.

Close-up of a reservoir

Panels tested at the University of Kentucky

Panels tested at the Missouri Portland Cement Company

TWENTY YEARS OF RESEARCH HA'E

Water can be made to pass through masonry units, also to pass through mortar, by maintaining a sufficient head of water, or by exposure to a sufficient amount of water over a long period of time.

But in the case of the great majority of brick walls which leak, water does not go through the masonry units or through the mortar. It works its way through cracks or channels between the masonry units and the mortar.

* * * *

The cracks which you see in brickwork are usually due to one of the two following causes:

(1) Sometimes a good bond is not secured between the brick and the mortar at the time the brick is laid, because the brick on which the mortar is spread withdraws so much water from the mortar that the mortar is sucked dry before the next brick comes into contact with it. Brick will not bond properly unless the mortar is still soft and plastic. (See page 7)

(a) When placed on absorbent brick, a mortar with high water-retaining capacity will stay soft and plastic longer than a mortar with low water-retaining capacity.

(b) If the bricks' rate of absorption is too high at the time they are laid, they will suck the water out of the mortar too fast, even though the mortar has high water-retaining capacity.

To insure a good bond, absorbent brick must be thoroughly wet and not allowed to dry out before they are placed in the wall.

(c) A good bond between brick and mortar depends more upon the suction of the brick than it does upon the mortar materials.

. . . AND BECAUSE OF THESE FACTS, THE FOLLOWING

Dry walls will be secured whenever th

(1) Mortar shall be mixed and kept tempered on the boards, so it will at all times contain as much water as it is able to carry. (See page 8)

(2) The mortar shall have high water-retaining capacity and plasticity.

Mortar of the materials and proportions used on the job, when mixed and tested in accordance with Section 30 of A.S.T.M. Specification for Masonry Cement, Designation: C91-51, shall have a flow after suction greater than 70% of the flow immediately after mixing.

The plasticity of the mortar shall be thoroughly satisfactory to the mason. (See page 8)

(3) The brick shall have a low rate of suction at the time they are placed in the wall. To secure this low rate of suction, when absorbent brick are used, they shall be thoroughly wetted and not allowed to dry out. The suction of the brick shall be so reduced by wetting that specimens of brick, taken from the scaffold, shall not gain more than 20 grams (7/10 of an ounce) in weight, when placed in ⅛″ to ¼″ of water, for one minute. (See page 9)

ESTABLISHED THESE FACTS . . . .

(2) Sometimes immediately after the brick is laid, the bond is broken by the bricklayer in his attempt to get perfect alignment. If he changes the position of the brick in any way, after the mortar has already congealed, he will break the bond. (See page 7)

Some cracks, formed in this way, are inevitable on any job.

*   *   *   *

The amount of water which will enter cracks in the face of the wall can be reduced, if all joints on the exterior face of the wall are tooled to give a concave finish. This helps seal the cracks between the brick and the mortar.

*   *   *   *

Even if the mortar has high water-retaining capacity, the brick have been wetted, and the joints have been tooled, some water will inevitably penetrate the face of the wall. Therefore the following precautions should be taken to prevent it from reaching the back of the wall:

All head joints and bed joints should be filled solid with mortar. Voids or channels in the mortar joints provide an easy passage for any water which has penetrated through cracks in the face of the wall.

The face brick should be backplastered before the back-up units are laid. This provides an effective barrier to any water which may find its way through the outside 4″ of the wall.

SPECIFICATIONS ARE RECOMMENDED

ollowing precautions are specified and enforced

(4) All head joints and bed joints on the exterior face of the wall shall be tooled to give a concave finish. This shall be done with a round tool slightly larger than the joint, before the mortar hardens, and with sufficient force to press the mortar tight against the brick on both sides of the joint. (See page 12)

(5) All head joints and bed joints in both face brick and back-up work shall be completely filled with mortar. (See pages 10 and 11)

(6) Before the back-up units are laid, the face brick shall be backplastered with mortar ⅜″ thick, or of sufficient thickness to insure complete coverage between the header courses. If the back-up units are laid first, the front of the back-up units shall be plastered, before the face brick are laid. (See page 13)

WATER PENETRATES THROUGH CRACKS AND OPENINGS BETWEEN THE BRICK AND MORTAR

When a masonry wall leaks, water almost never passes through the masonry units or through the mortar. It works its way through cracks* or channels between the masonry units and the mortar. This is the unanimous opinion of all who have made a careful study of the leaky brick wall problem.

Newman (1) says, "In the hundreds of leaky buildings we have had occasion to inspect, not one has shown signs of running water due to the absorption of masonry units."

Lent (2) says, "Open or partially filled mortar joints permit water to penetrate the outer course of brick."

Palmer (3) says, "Water penetrates through brick masonry chiefly through cracks and openings *between* bricks and mortar rather than through these materials themselves."

Anderegg (4) says, "Most of the leakage occurs between the mortar and the brick."

Mallon (5), Anderegg (6), and McBurney (7), by the use of dye, traced the passage of water between the brick and the mortar.

**These cracks are not due to "shrinkage" of mortar. Data obtained during an extensive study at the Bureau of Standards indicate that "shrinkage" is not damaging to the bond between the mortar and brick.*

The maximum shrinkage which could occur in a mortar joint between absorbent brick is so small that it could not cause a crack visible to the human eye. "Shrinkage" cannot account for leaks in a brick wall.

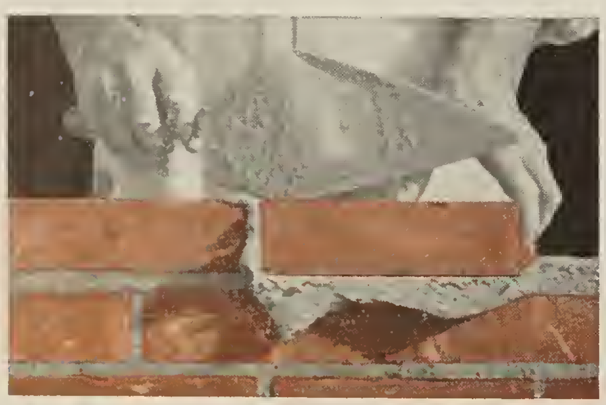
Palmer (8) says, "When the extent of bond is practically complete, the results do not indicate an appreciable weakening of the bond through shrinkage of mortar during early hardening.

"There is no evidence that volume changes in mortar subsequent to hardening destroyed or weakened the bond either in vertical or horizontal joints, when the extent of bond is good."

McBurney (7) says, "Such openings are especially noticeable on struck joints and have been mistaken by inexperienced observers for shrinkage cracks."

In his discussion of McBurney's paper (7) Anderegg says, "I agree with the authors that when certain people talk about 'shrinkage cracking' they are basing their estimate on incorrect observation."

When joints are cut flush with the brick, cracks are immediately apparent between the brick and the mortar at the surface of the wall. These cracks do not extend back through the entire width of the brick. They go back only a fraction of an inch, and are not deep enough to cause leaks. Such cracks are not due to shrinkage. The pictures below explain how they occur.



When the bricklayer taps the brick down to the line, the mortar in the bed joint oozes out, and hangs down over the wall, pulling away from the edge of the brick above.

If this excess mortar is cut off with a sideward stroke, the mortar is not pushed up against the edge of the brick above, and a surface crack remains on top of the joint.

If the bed joint is cut off with an upward stroke, the trowel pulls the mortar away from the edge of the brick below, and a surface crack is opened below the bed joint.

If the head joint is cut off with an upward stroke of the trowel, no surface crack appears.

If a sideward trowel stroke is used to cut off the head joint, the trowel pulls the mortar away from the brick and forms a surface crack on the side from which the stroke was made.

MOST CRACKS THROUGH WHICH WATER CAN PASS ARE DUE TO ONE OF TWO CAUSES:

(1) A good bond was not secured at the time the brick was laid

Failure to secure a good initial bond between the brick and the mortar is usually due to the fact that the brick on which the mortar is spread withdraws so much water from the mortar that it is sucked dry before the next brick comes into contact with the mortar.

Here the brick on which the mortar was spread withdrew so much water from the mortar that the mortar dried out before the next brick came into contact with it

Brick will not bond properly with mortar unless the mortar is still soft and plastic.

Here the mortar was still soft and plastic when the next brick was placed

(2) The bond was broken after the brick was laid

Sometimes shortly after the brick is first laid, but after the mortar has stiffened, the bricklayer changes slightly the position of the brick in his attempt to get perfect alignment.

If the mortar has already congealed, *any* movement of the brick will break the bond.

He may lift the brick from the mortar bed and reset it

He may shift the brick to even out the head joints

He may hammer down the back edge of the brick to bring it down level with the line, and thereby tilt up the front edge

He may hammer a brick back into line after a course has been laid on top of it.

He may tap a corner brick back to make it plumb with the face of the wall

HOW LEAKS CAN BE PREVENTED

MORTAR SHOULD NOT BE ALLOWED TO DRY OUT ON THE BOARD

Mortar should be mixed and kept tempered on the board, so the mortar will contain as much water as it is able to carry, whenever the bricklayer picks up a trowel full of mortar.

Mortar on the boards should be kept well tempered with water

Data obtained by M. O. Withey (9), of the University of Wisconsin, indicate that the most complete contact of mortar with brick, and joints of highest tensile strength, are likely to be obtained if the mortar is as wet as may be used conveniently. Anderegg (6) says, "The wetness of the mortar is the most important single factor in securing complete contact with an absorbent unit."

THE MORTAR SHOULD HAVE HIGH WATER-RETAINING CAPACITY

Water-retaining capacity is the ability of a mortar to retain its moisture, and hence its plasticity, when spread out on porous brick.

When placed on absorbent brick, a mortar with high water-retaining capacity will stay soft and plastic longer than mortar with low water-retaining capacity.

If the mortar does not have high water-retaining capacity, it is too quickly sucked dry by the brick; the mortar stiffens too soon, the brick cannot be properly bedded, and a good bond cannot be obtained.

For all practical purposes, the water-retaining capacity of a mortar can be judged by its plasticity. Mortars which have excellent plasticity have high water-retaining capacity. Mortars which have poor plasticity have low water-retaining capacity.

Palmer (10) says, "A poorly workable mortar invariably has low water-retaining capacity."

If the mortar does not have high water-retaining capacity, the mortar stiffens too soon and a good bond cannot be obtained

Palmer (8) says, "The data indicate that the water retaining capacity of mortars and absorption rate of bricks were of primary importance in obtaining a good bond." Parsons (11), says, "The essential quality of mortar was found to be workability and water retentivity. Workable mortars which stiffened slowly when in contact with absorptive units were desired by the masons, and more satisfactory walls were obtained with them than with mortars which stiffened rapidly." Anderegg (12) says, "Trouble is usually due to the presence of depressions in the mortar surface in contact with the brick, caused apparently by incomplete wetting of the brick by the mortar, or by too rapid moisture removal while the mortar is still plastic, or both."

THE BRICK SHOULD HAVE A LOW RATE OF ABSORPTION AT THE TIME THEY ARE LAID

A good bond between brick and mortar depends more upon the suction of the brick than it does upon the mortar materials.

If at the time the brick are laid, their rate of absorption is too high, they will suck the water out of the mortar too fast, even though the mortar has high water-retaining capacity.

In so far as the bond is concerned, best results are secured with brick having a low rate of absorption at the time they are laid.

To secure a low rate of absorption it is necessary to wet absorbent brick. Except for impervious types, all brick should be thoroughly wetted to reduce their suction, and not allowed to dry out before they are placed in the wall.

If brick taken from the scaffold will gain more than 20 grams (7/10 of an ounce) in weight when placed flat in $\frac{1}{8}''$ to $\frac{1}{4}''$ of water for one minute, their rate of absorption is too high and must be reduced by wetting or re-wetting.

McBurney (7) says, "It is well recognized that the initial rate of absorption of clay and shale building bricks is one of the important factors affecting the water permeability of brick-mortar combinations in masonry.

"Differences in bricks had much more effect on permeability than differences in mortar."

Anderegg (12) says, "The rate at which moisture is removed from the mortar by the brick has a marked influence on the bond strength and water-tightness of the wall."

Palmer (13) says, "The data indicate that although the maximum rate of water transmission varied both with the brick and mortar used, it was affected relatively more by the brick than by the mortar.

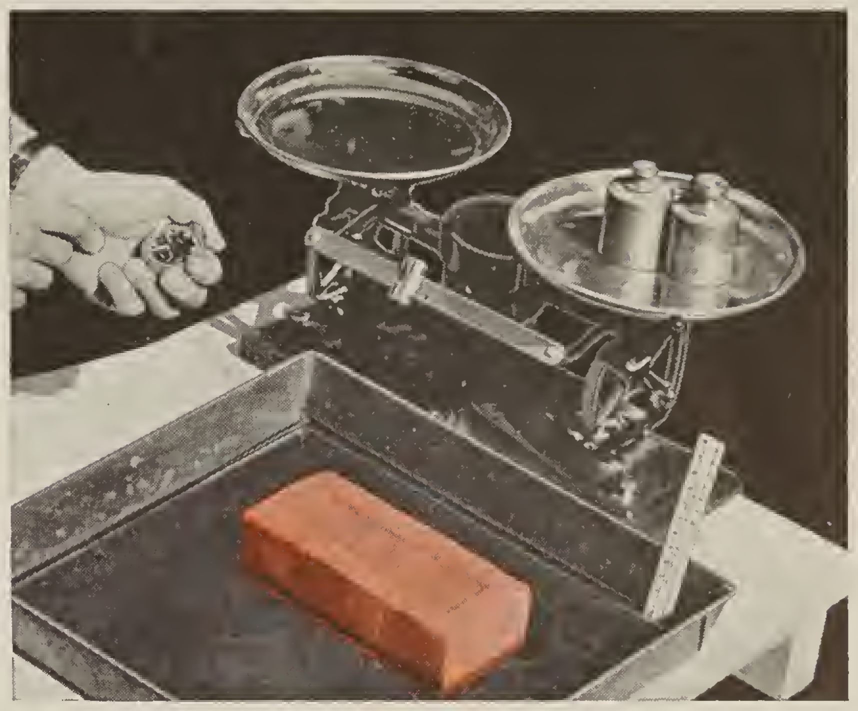
"The test results show that, irrespective of the properties of the mortar used, the leakage of the specimens was less when bricks of moderate or high suction were wetted before laying than when they were set dry."

Parsons (11) says, "With bricks having too high a rate of absorption, there is a tendency for the mortar to lose water rapidly and to become too stiff to form a complete bond with the brick. Although the rate of stiffening of mortar when in contact with absorptive units is minimized by the use of mortars of easy working properties and high water retaining capacity, strong and watertight joints were not obtained with mortars which were best in these respects unless bricks having high rates of absorption were wetted before laying."

Fishburn (14) says, "The great importance of thoroughly wetting brick before they are laid should not be minimized. If the brick suction is not determined, care should be taken to have all brick well wetted and, if possible, nearly saturated at the time of laying. Little difficulty should be experienced in laying brick that are nearly saturated so long as no water is visible on the surfaces of the brick. This may involve frequent wetting, especially for high absorptive brick laid in hot, dry weather.

"Walls having a satisfactory resistance to rain penetration may be built of bricks, regardless of the method of forming or manufacture of the bricks, provided the absorption of the bricks at the time of laying is kept within the proper limit by preliminary wetting."

Anderegg (12) says, "Bricks of higher absorption rate should have their excess sucking power diminished by wetting."



Brick should be taken from the scaffold and checked for rate of absorption

This does not mean, however, that impervious brick or brick with low absorption should be specified. A considerable amount of absorption is a very desirable property of brick in the finished wall. This is particularly true of back-up units. If the wall is built entirely with units of low absorption, any water that enters through cracks is apt to go right on through the wall. But if the back-up units have a certain amount of absorption, these softer units, acting somewhat like a sponge, will absorb and hold back the water. Later, when the sun hits the face of the wall, the moisture will evaporate out again, almost as though the wall were breathing.

Fishburn (14) says, "High absorptive brick provided a time-factor of safety that walls built of the low-absorptive brick did not possess."

Palmer (13) says, "When the joints are not completely filled with mortar, water is more apt to penetrate into the interior of the building if the bricks are very impervious than would be the case were the bricks porous."

McBurney (15) says, "The volume of water capable of being absorbed is an important factor in delaying striking through of moisture."

Palmer (13) says, "Brick No. 5, smooth and very impervious, is of special interest since it is a type of unit that has been widely associated with leaking buildings. Since it is incapable of absorbing any appreciable amount of water, it is obvious that water entering through joints left unfilled by the mason in walls of this brick must either be absorbed by the more porous back-up materials, descend between the back of the wall and the furring, or else penetrate into the interior of the building."

HEAD JOINTS AND BED JOINTS SHOULD BE FILLED SOLID

If the joints are not filled solid with mortar, voids and channels are left, which provide easy passage for any water which has penetrated through cracks in the face of the wall.

When a dab of mortar is spotted on one corner of the brick,

the mortar does not fill the head joint

Only part of the head joint is filled with mortar

Slushing does not properly fill the voids in the head joints

When mortar is spotted on only one corner of the brick, slushing seldom fills the voids

Even when mortar is spotted on both corners, slushing will not always fill the voids

Even when mortar is spotted on both corners of the header brick, there is not enough mortar in the joint

Slushing will seldom fill the voids

When hollow back-up units are used, the head joints in the interior of the wall, next to the face brick, should not be left open

If all joints are not full of mortar, back-up units give little protection

WITH MORTAR

All head joints and bed joints in both face brick and back-up work should be completely filled with mortar. This is the most important precaution which can be taken to secure a dry wall.

A thick bed of mortar should be spread on the wall

The furrow in the mortar should be shallow, not deep

Then the excess mortar will fill the furrow and insure full bed joints

Plenty of mortar should be thrown on the end of the brick to be placed

The brick should then be pushed into place

so that the mortar oozes out at the top of the head joint

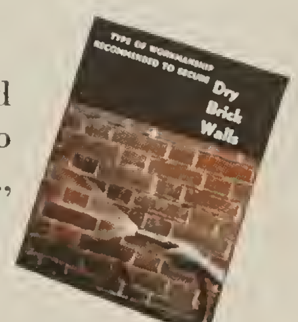
Mortar should be spread over the entire side of the header brick before it is placed

The brick should be shoved into place so that mortar oozes out at the top of the joint

This completely fills the joint

Newman (16) says, "Where workmanship has been the cause of leaking walls, it has been due in most cases to lack of sufficient mortar in the end joints." Coe (17) says, "The factor most important to moisture proof brickwork—the good workmanship necessary to completely fill all joints with mortar." Parsons (18) says, "The quality of the workmanship had a far greater effect than any other visible factor in the study." Anderegg (12) says, "Upon the bricklayer's workmanship, more than upon any other single factor, rests the responsibility for the integrity of the wall." Fishburn (14) says, "Workmanship was found to be the most important factor affecting the permeability of masonry walls."

The type of workmanship which should be specified to secure dry brick walls is explained and illustrated in the manual shown on the right. A copy will be sent free, without obligation, to any architect, contractor, bricklayer, or dealer who requests it. Write the Louisville Cement Co., Louisville, Kentucky, for this "Workmanship Book".



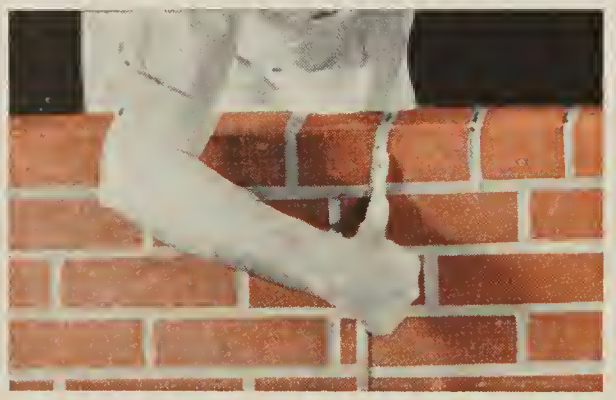
JOINTS SHOULD BE TOOLED TO GIVE A CONCAVE FINISH

The amount of water which will enter cracks in the face of the wall can be reduced, if all joints on the exterior face of the wall are tooled to give a concave finish. Such tooling helps seal the entrance to the cracks between the brick and the mortar.

Concave tooling helps seal the entrance to any cracks between the brick and the mortar

Stanley Newman (16) says, "The joints that afford the best protection are those of the weathered and concave type. These not only present an excellent surface for the shedding of water, but require for their formation an amount of pressure sufficient to compress the mortar and create a firm bond between the mortar and the brick at the face of the wall, thereby reducing the probability of hidden cavities." The Committee on Materials and Methods of the Boston Society of Architects (19) says, "The Committee recommends that too wide a joint be avoided and that all joints should be ruled with a jointing tool. The most weathertight type of joint seems to be formed by a pipe jointer making a slightly concave surface." Anderegg (12) says, "A careful tooling of the joint is sometimes literally the final touch needed to make the joint watertight. Cases have been known where identical conditions of bricklaying prevailed in the same building, but the joints were part scored and part pointed with a round tool. The former leaked, while the latter did not, in spite of similar exposure."

Tooling should be done with a round tool slightly larger than the joint, before the mortar hardens, and with sufficient force to press the mortar tight against the brick on both sides of the mortar joint.



Before the mortar hardens, joints should be tooled with sufficient force to press the mortar tight against the brick on both sides of the mortar joint

Concave joints should always be used for face brick, unless the architecture requires some other type of finish. No other type of joint provides as much protection against the entrance of water.

A weathered joint does not always pack the mortar against the top brick thoroughly

A struck joint leaves a shelf on which water collects

A raked joint leaves a bad shelf and often contains too little mortar

THE FACE BRICK SHOULD BE BACK-PLASTERED

Before the back-up units are laid, the face brick should be backplastered with mortar 3/8" thick, or of sufficient thickness to insure complete coverage between the header courses. If the back-up units are laid first, the front of the back-up units should be plastered, before the face brick are laid.

This provides an effective barrier to any water which may find its way through the outside 4 inches of the wall. This is especially true if a waterproofed mortar is used.

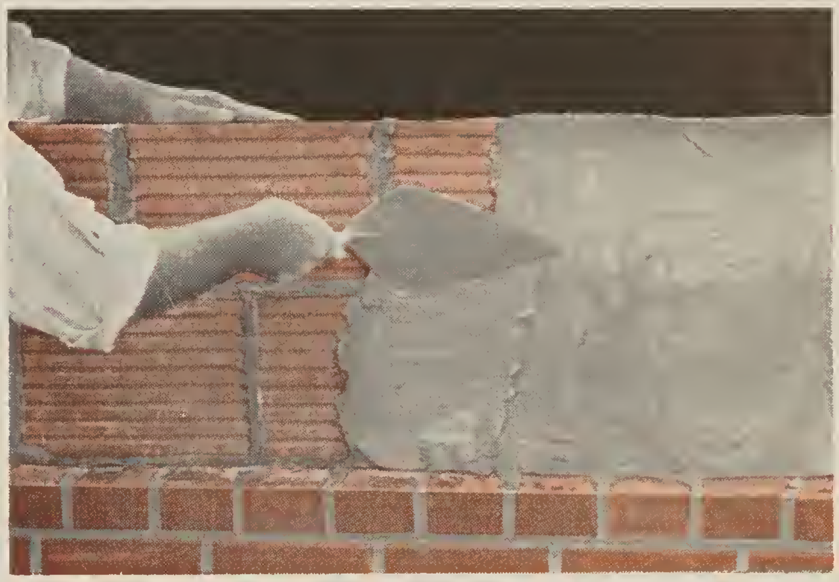
The Committee on Materials and Methods of the Boston Society of Architects (19) says, "The Committee recommends that the back of all face brick be parged with mortar of the same mix as that in which the brick is laid, as the wall progresses in height; that is, after five or six courses of face brick are laid, parge the back of this brick before placing the backing. This work should be thoroughly done so that no voids may be left which may permit the passage of moisture into the backing. This will also tend to fill up the end joints of masonry work."

Parsons (18) says, "The plastering of mortar on the back of 4-inch walls resulted in masonry of high resistance to rain penetration."

Bevier (20) says, "Before the tile are set, the back side of the face brick should be entirely covered with enough mortar to fill the space between the brick and the tile."

The Technical News Bulletin of the National Bureau of Standards (21) says, "The application of a pargeting of mortar on the back of the facing wythe helped to make walls more resistant to moisture penetration."

The face brick should be back-plastered with 3/8" of mortar, before the back-up units are laid



If the back-up units are laid first, the front of the back-up units should be plastered

SLUSHING DOES NOT TAKE THE PLACE OF BACK-PLASTERING

Frequently specifications are written providing either that the face brick should be back-plastered or that the space between the face brick and the back-up units should be slushed full of mortar.

Slushing does not give the same protection against the penetration of water that back-plastering gives.

It is almost impossible by slushing to completely fill the space between the face brick and the back-up work. Frequently the mortar is caught and held before it reaches the bottom of the narrow crevass, leaving openings between the face brick and the back-up units.

Even when this space is filled, there is no way to compact the mortar against the face brick. The mortar does not bond with the brick over its entire surface. Channels are left between the mortar and the brick, through which water can trickle down behind the face brick until it finds a header or a floor along which it can travel to reach the back of the wall.

Slushing does not completely fill the space between the face brick and the back-up work

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For thirty-five years, Brixment has been recognized as the leading masonry cement. It is designed to produce mortar combining plasticity, water retention, bonding quality, strength, durability and freedom from efflorescence.

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THE AMERICAN INSTITUTE OF ARCHITECTS
THE OCTAGON, 1741 NEW YORK AVENUE, N.W., WASHINGTON 6, D. C.

December 21, 1950

Mr. John H. Mallon, Vice President
Louisville Cement Company, Inc.
Speed Building
Louisville, Kentucky

Dear Mr. Mallon:

The importance of sound masonry construction, from the standpoint of the stability of the structure, as well as the avoidance of the results of moisture penetration, and excessive maintenance costs, cannot be over emphasized.

In the publication, some five years ago, of "TYPE OF WORKMANSHIP RECOMMENDED TO SECURE DRY BRICK WALLS," you made a worthwhile contribution to sound construction of informative value to architects and builders.

Your new publication, "SPECIFICATIONS RECOMMENDED TO SECURE DRY BRICK WALLS," makes available not only the specification requirements for sound, moisture resistant brick masonry but illustrates the techniques of brick laying necessary to insure these results.

In so adequately presenting the results of twenty years of painstaking research you have again directed attention to the fact that sound, moisture resistant brick masonry depends upon those who design and specify the work, the contractors who construct the same, and the craftsmen responsible for its field fabrication.

Sincerely yours,

Theodore Irving Coe

Theodore Irving Coe
Technical Secretary

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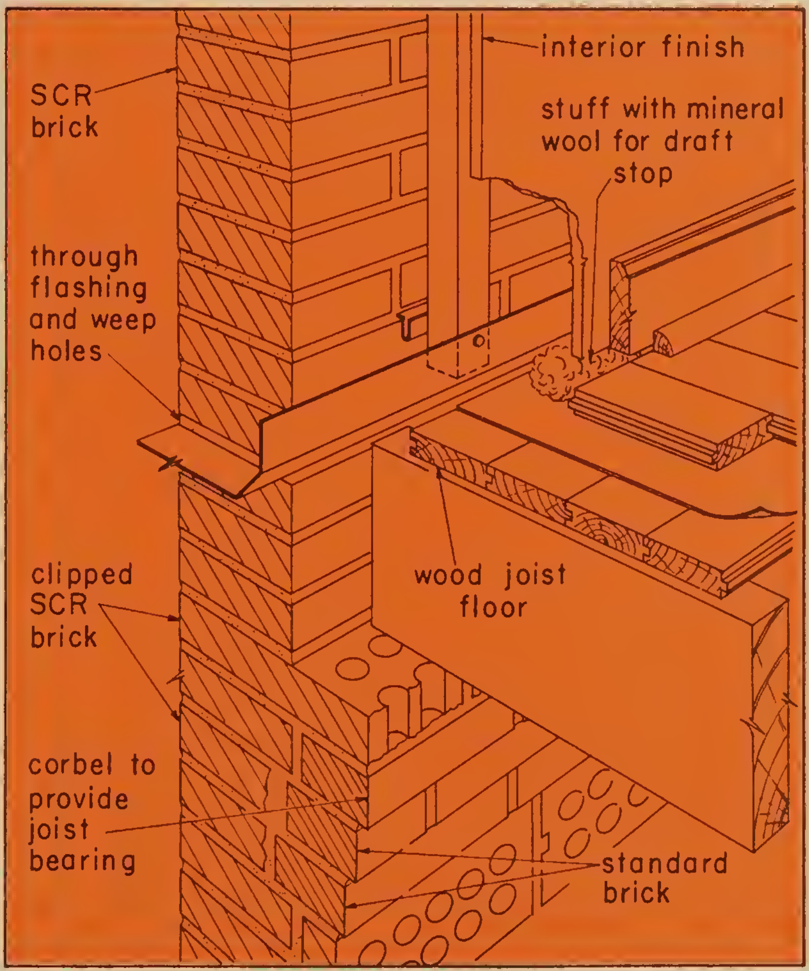
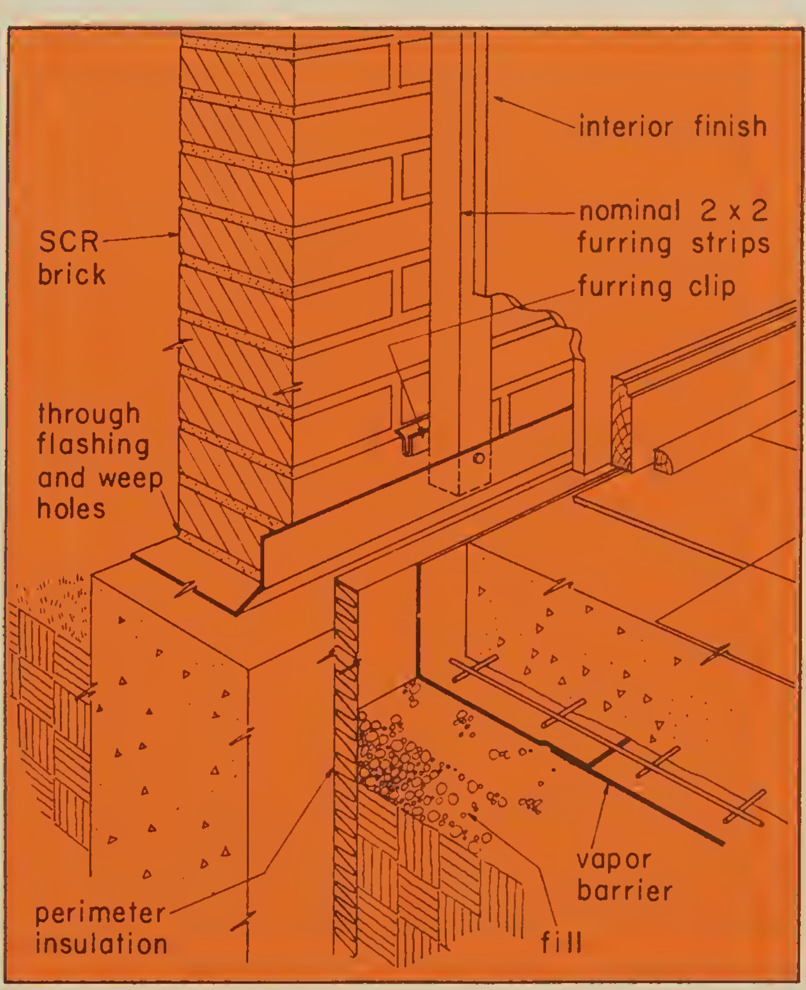
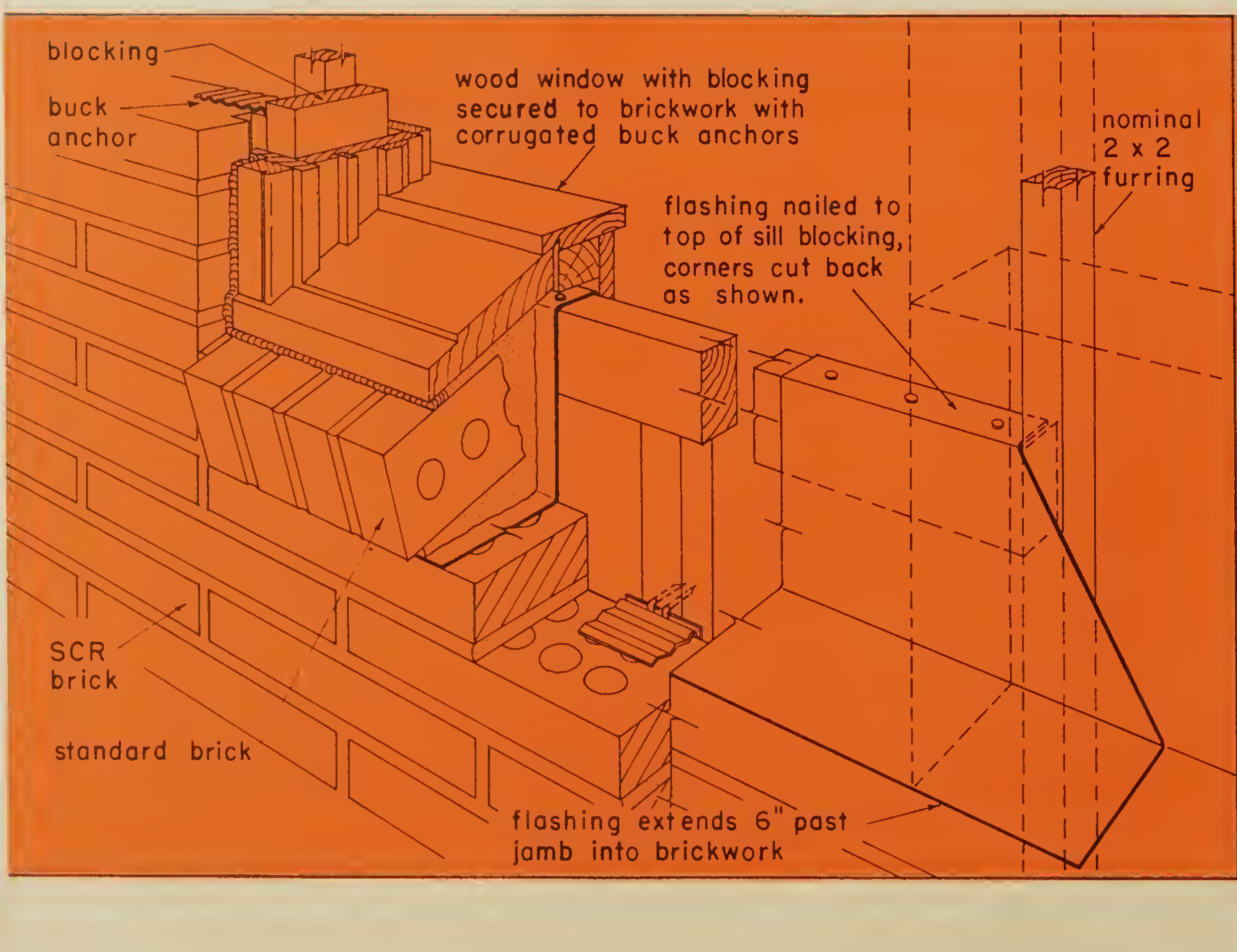
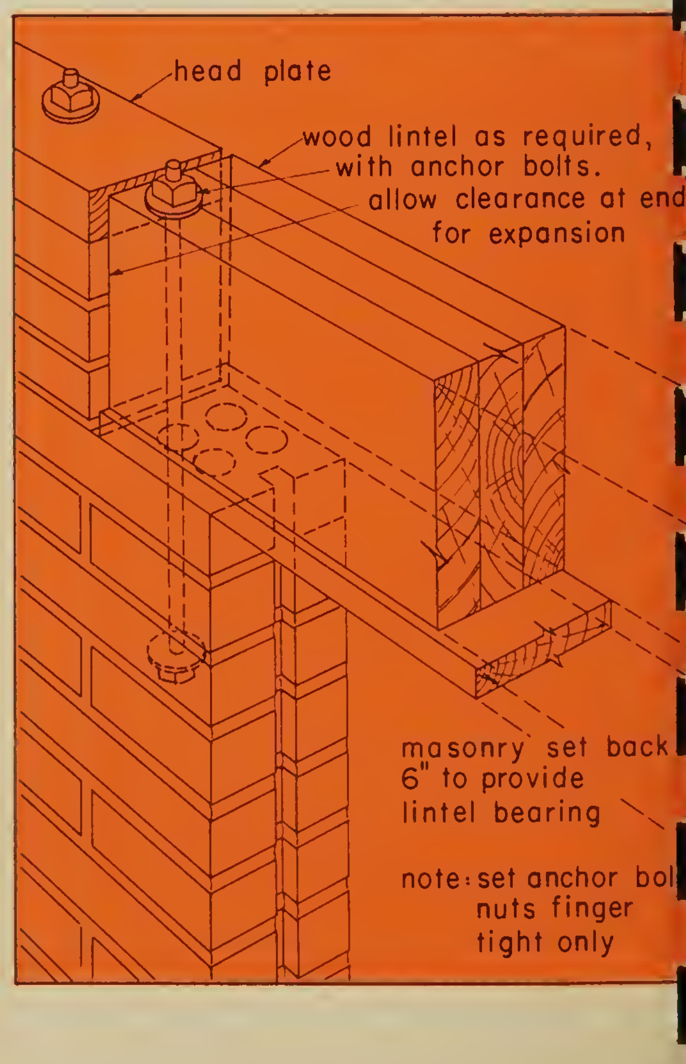


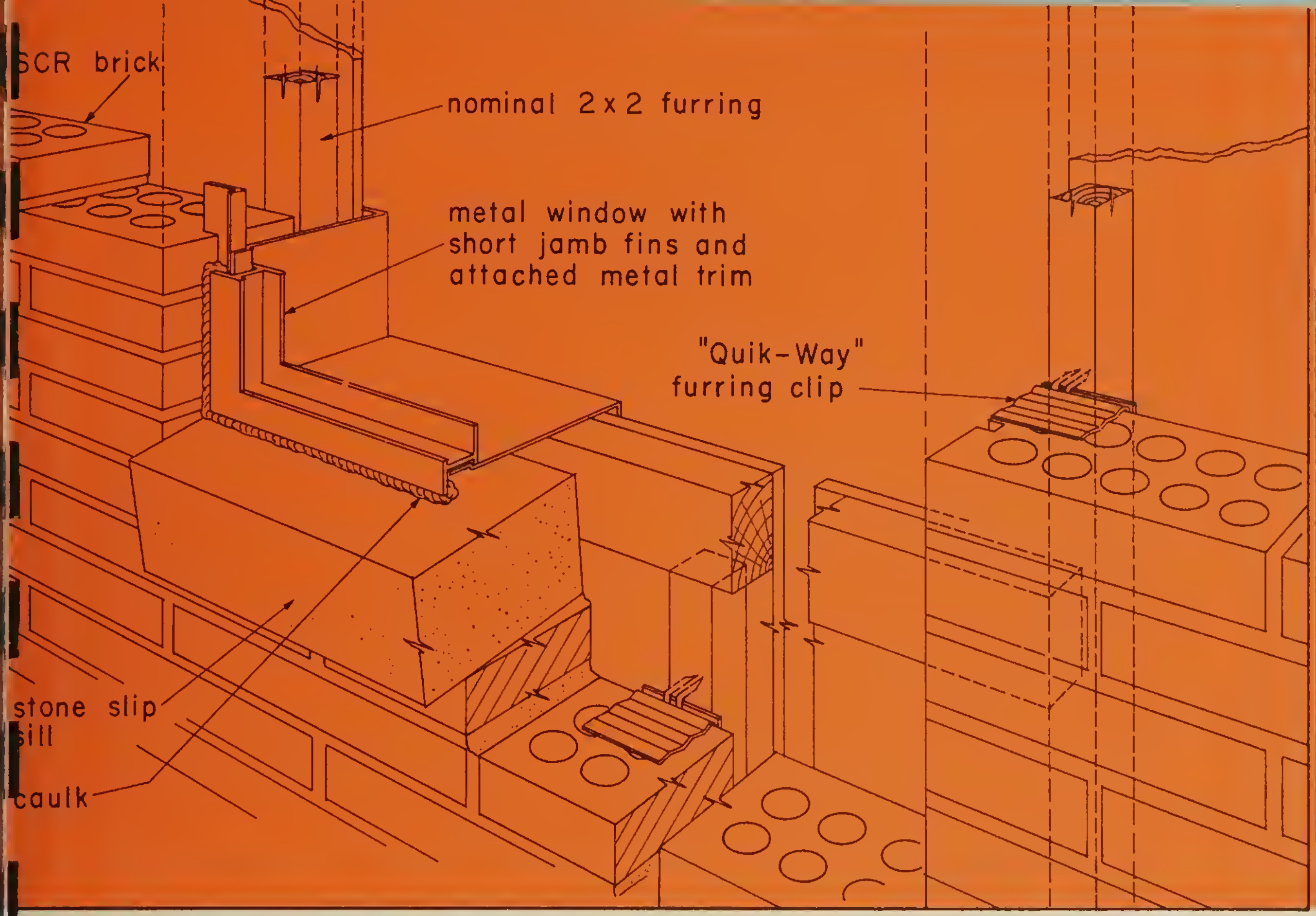


Stock wood or metal windows may be installed in "SCR brick" walls with no difficulty. The "SCR brick" is provided with a ¾x¾-in. jamb slot to receive the metal "fin" of a steel window or the blind stop extension of a wood double-hung window. When properly caulked, such an installation at the jambs will provide a positive weather stop. Since in most cases the window and door heads will be only three brick courses below the top of the wall, either reinforced brick masonry or wood lintels can be used very economically. Opening spans up to 12 ft. in length can be spanned by placing four ¼-in. reinforcing bars in the first horizontal mortar joint above the opening. If steel lintel angles are used, the horizontal leg of such angles must be 6 in. long. Customary practices of placing flashing under sills and over heads of openings should be followed.

WINDOW DETAILS

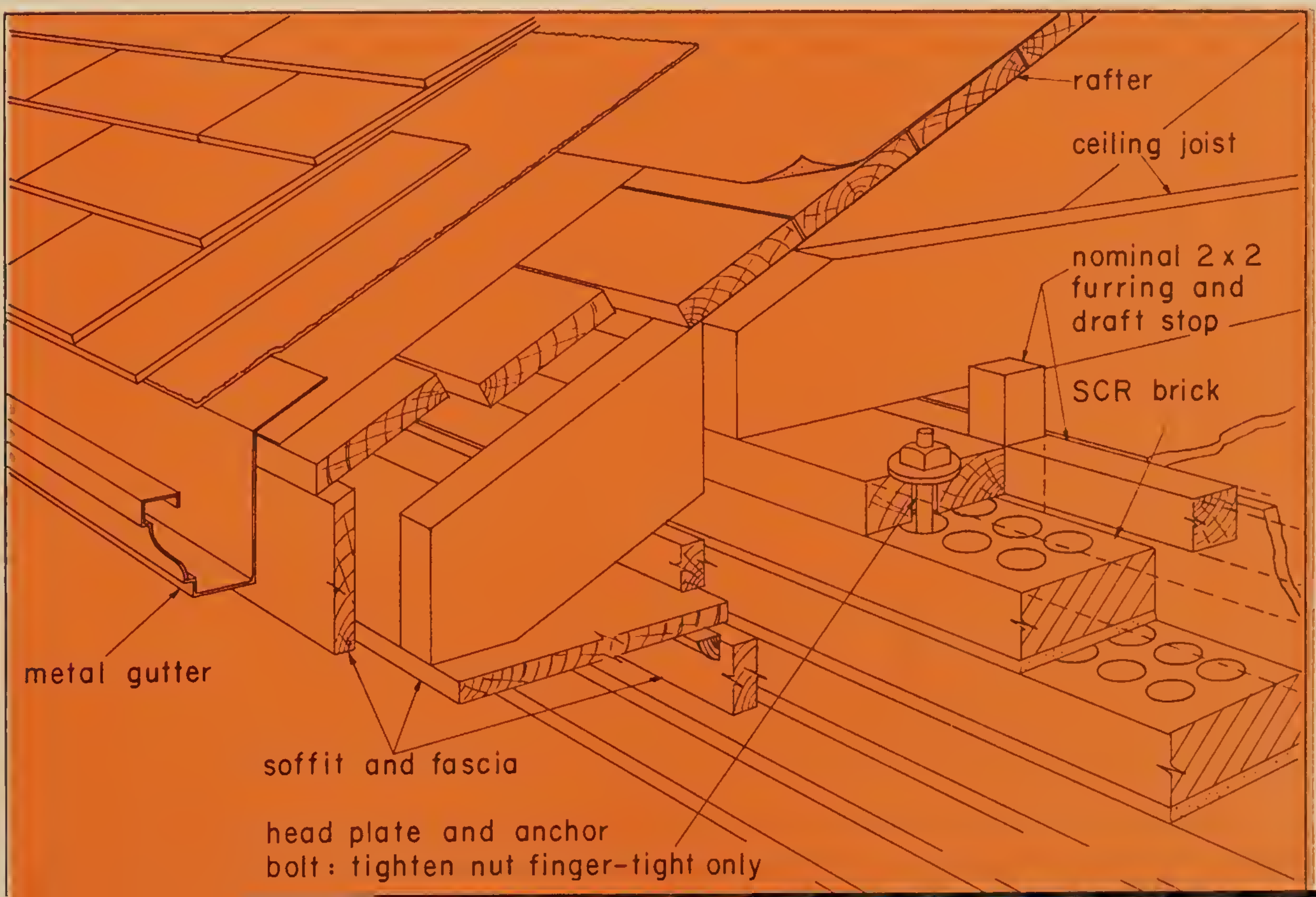






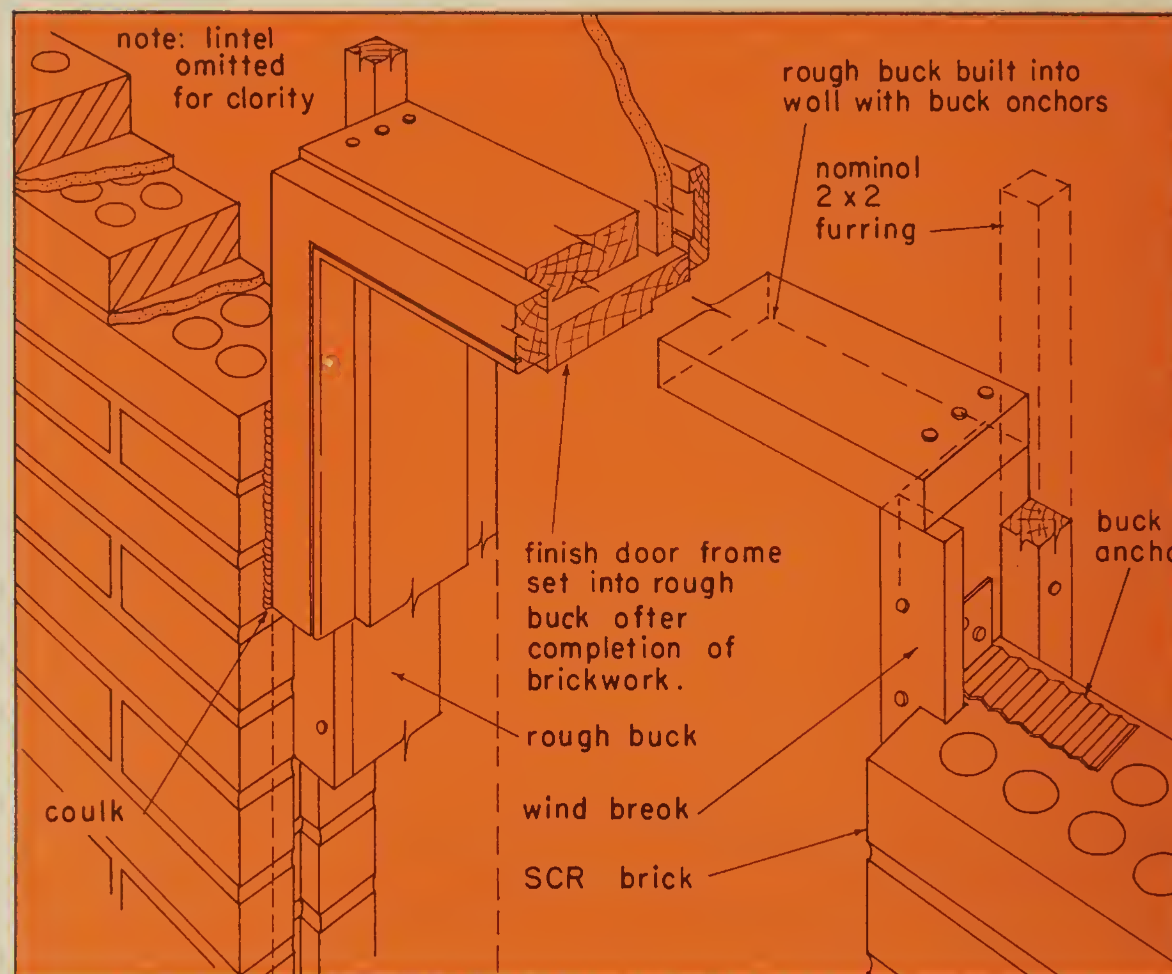
ROOF PLATE

The continuous 2x6-in. head plate is anchored to the "SCR brick" wall with anchor bolts of sufficient length to extend into the wall at least 8 in. or to depth required by local codes. If ⅜-in. bolts are used they should be spaced not more than 4 ft. apart. With ½-in. bolts, 8 ft. spacing may be used. The anchor bolts should extend through the head joints in alternate courses and may pass through one of the 1-⅜-in. cores in other courses. To prevent "bowing" of the plate, the position of the anchor bolts should be staggered.



EXTERIOR DOORS

Stock exterior doors may also be used in the "SCR brick" wall. Here again, the jamb slot provided in the brick should be utilized to provide a positive weather stop to prevent the entrance of wind-driven rain or air leakage around the frame. The rough bucks should be firmly anchored to the masonry jamb with suitable brick anchors.

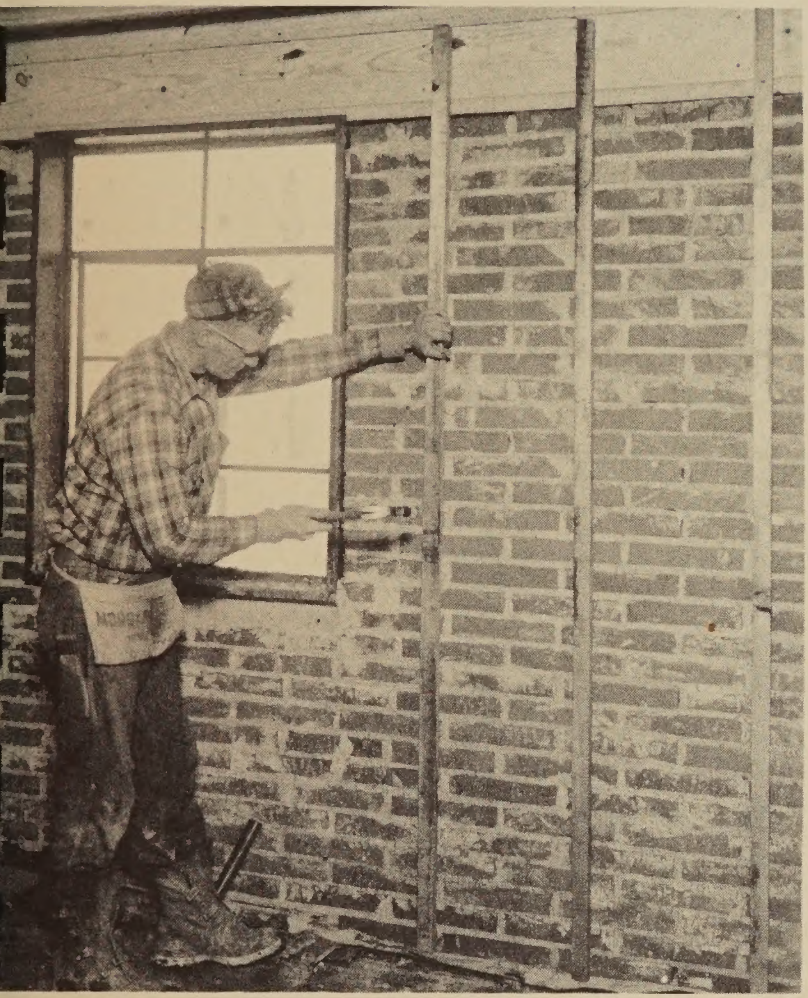


INSULATION VALUES

The use of the 2x2-in. furring strips allows a wide choice of insulating methods and, consequently, a wide variety of "U" values. The following table of Heat Transmission Coefficients for the "SCR brick" wall (corrected for 15 mph wind velocity) lists combinations of various interior finishes and insulation to fit particular insulation requirements. In each case, the interior finishes and insulation are attached to 2x2-in. furring strips.

	Type of Interior Finish and Insulation (2 x 2-in. furring)	U Factor
1.	1″ roll insulation, ½″ insulating board lath, ½″ vermiculite plaster	0.12
2.	1″ roll insulation, ⅜″ gypsum lath, ¾″ vermiculite plaster	0.14
3.	1″ roll insulation, metal lath, ¾″ vermiculite plaster	0.15
4.	1″ roll insulation, ⅜″ gypsum board (dry wall)	0.16
5.	1″ roll insulation, metal lath, ¾″ gypsum plaster	0.16
6.	1″ roll insulation, ⅜″ gypsum lath, ½″ gypsum plaster	0.16
7.	⅜″ gypsum lath with aluminum foil, ½″ vermiculite plaster	0.23
8.	½″ insulating board lath, ½″ vermiculite plaster	0.23
9.	½″ insulating board lath, ½″ gypsum plaster	0.25
10.	⅜″ gypsum lath with aluminum foil, ½″ gypsum plaster	0.25
11.	½″ gypsum board (dry wall) with aluminum foil	0.26
12.	Metal lath, ¾″ vermiculite plaster	0.33
13.	⅜″ gypsum lath, ½″ vermiculite plaster	0.33
14.	⅜″ gypsum lath, ½″ gypsum plaster	0.37
15.	Metal lath, ¾″ gypsum plaster	0.40

WALL CONSTRUCTION

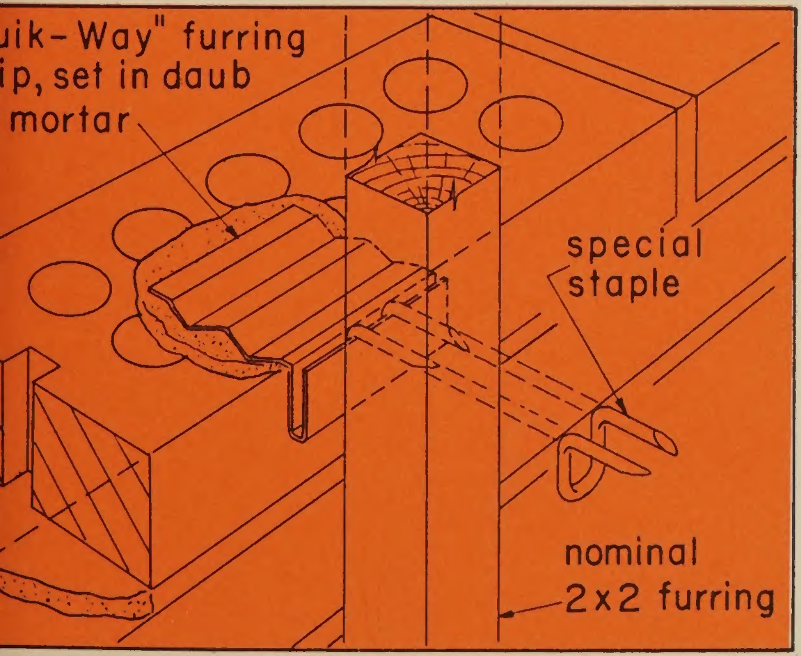


The "SCR brick" is designed for use with furring on which the interior surface finishes and insulation can be applied. It is recommended that nominal 2 x 2-inch furring be used, since this size will provide a "cavity" large enough to:

1. provide a barrier to moisture penetration
2. permit easy installation of electrical facilities
3. permit the use of blanket insulation as desired

The use of 2 x 2-inch furring strips, with their increased stiffness or rigidity, will allow the use of fewer furring clips or wall plugs to anchor the strips in place. Tests indicate that anchoring the furring strips at the bottom, mid-height and top will be adequate. Only two furring anchors will be required on the side walls, since the strips can be nailed to the top wall plate.

FURRING CLIPS



Although conventional methods of attaching furring to the "SCR brick" wall may be used, the "Quick-Way" furring clip shown here is recommended. A feature of this clip is the ease with which the position of the special nailing staple can be adjusted in a horizontal direction. The width of the clip is 3-inches which, together with the provision for sliding the staple horizontally, makes it unnecessary to line up the clips accurately when building the wall, thus greatly simplifying their installation. Another desirable feature of this clip is that its size will permit the furring strips to be held out from the face of the wall approximately ¼-inch. This permits air circulation back of the strips and the free drainage of any moisture which might be present down the back face of the wall out through weep holes in the bottom course.

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